DEPARTMENT OF
ECOLOGY
State of Washington

Chemical Test Methods

For Designating Dangerous Waste

WAC 173-303-090 & -100

Revised December 2014
Publication no. 97-407

Publication and Contact Information

This report is available on the Department of Ecology's website at
https://fortress.wa.gov/ecy/publications/SummaryPages/97407.html

For more information contact:

Hazardous Waste and Toxics Reduction Program
P.O. Box 47600
Olympia, WA 98504-7600

Phone: 360-407-6700

Washington State Department of Ecology - www.ecy.wa.gov

○ Headquarters, Olympia	360-407-6000
○ Northwest Regional Office, Bellevue	425-649-7000
○ Southwest Regional Office, Olympia	360-407-6300
○ Central Regional Office, Yakima	509-575-2490
○ Eastern Regional Office, Spokane	509-329-3400

Accommodation Requests:
To request ADA accommodation including materials in a format for the visually impaired, call Ecology at 360-407-6700. Persons with impaired hearing may call Washington Relay Service at 711. Persons with speech disability may call TTY at 877-833-6341.

Chemical Test Methods

For Designating Dangerous Waste

WAC 173-303-090 & -100

Hazardous Waste and Toxics Reduction Program
Washington State Department of Ecology
Olympia, Washington

This page is purposely left blank

Table of Contents

CHAPTER 1: Regulatory Testing Requirements

CHAPTER 2: Dangerous Waste Designation

CHAPTER 3: Analytical Test Methods

Appendices

Tables

Acknowledgements

Prepared by Samuel Iwenofu. Other Ecology staff who participated in updating this document includes:

- Alex Stone
- Jerry Yokel
- Robert Rieck

No statutory or regulatory requirements are in any way altered by any statement(s) contained herein.

For more information, please contact Samuel Iwenofu at 360-407-6346.

Chapter 1

Regulatory Testing Requirements

1.0. Introduction

This manual is intended to provide assistance for choosing chemical testing methods for suspected dangerous wastes. In Washington State, the *Dangerous Waste Regulations*, Chapter 173-303 WAC, require all generators to designate their waste to ensure proper management. "Dangerous wastes" are solid wastes designated in WAC 173-303-070 through 173-303-100 as dangerous, extremely hazardous, or mixed waste[1]. Generators may designate their waste based on process knowledge or by using methods accepted by the Department of Ecology (Ecology).

Certain recycling activities have specific regulatory testing requirements. Examples include burning used oil for energy recovery, and evaluating dangerous waste specifically for land disposal. The Land Disposal Restrictions (LDR), allow a waste to be land disposed only if specific thresholds are not exceeded[2]. Table 1-1 identifies sections of the regulations that have specific testing requirements.

Table 1-1: Sections of the Rule That Have Regulatory Testing Requirements

WAC Section	Section Title
173-303-090	Dangerous waste characteristics
173-303-100	Dangerous waste criteria
173-303-120	Recycled, reclaimed, and recovered wastes
173-303-140	Land disposal restrictions
173-303-300	General waste analysis
173-303-500	Recycling requirements for state-only dangerous waste
173-303-515	Special requirements for used oil burned for energy recovery

1.1 Purpose

Within this document, Ecology addresses the testing requirements of:

- Section WAC 173-303-090, Dangerous Waste Characteristics of the *Dangerous Waste Regulations*.
- Section WAC 173-303-100, Dangerous Waste Criteria of the *Dangerous Waste Regulations*.
- Testing requirements no longer required by the United States Environmental Protection Agency (EPA) but retained by the State of Washington.
- Other regulatory testing requirements may apply.

If the generator manages a waste in such a way that regulatory requirements other than WAC 173-303-090 and -100 apply, the generator must also comply with the testing requirements of those sections.

1.2 Dangerous Waste Characteristics and Criteria

Dangerous waste characteristics are defined under four categories:

1. Ignitability
2. Corrosivity
3. Reactivity
4. Toxicity

These four characteristics are based largely on federal requirements. Chapter 2 of this document will provide additional information on these characteristics.

Dangerous waste criteria are defined as:

1. Toxic dangerous wastes.
2. Persistent dangerous wastes.

Washington State developed these criteria in addition to the federal characteristics. The toxicity of a waste is determined by either using the methods in *Biological Testing Methods,* Ecology publication 80-12 (most recent revision), or by conducting a book designation[3]. A book designation can only be done when the generator has sufficient knowledge of the waste to identify its contents and amounts. Toxicity criteria and book designation are addressed in Chapter 3. There are two categories of Persistent dangerous wastes: halogenated organic compounds (HOC) and polycyclic aromatic hydrocarbons (PAH). Persistence and HOCs are discussed in Chapter 3.

This document will provide for all dangerous waste characteristics and criteria: (1) a description, (2) the regulatory definition, and (3) a link to EPA's web site containing all the methods in SW-846 (*www.epa.gov/epaoswer/hazwaste/test/main.htm*). SW-846 is a collection of analytical methods provided by EPA, some of which are used to determine whether a waste is dangerous.

1.3 Retained Testing Requirements

In 2005, EPA published in the Federal Register notification that the Methods Innovation Rules (MIR) removes the requirement to use certain SW-846 test methods to designate dangerous waste as required by RCRA. However, EPA retained use of SW-846 methods in the final rule for test methods that measure "methods defined parameters." Ecology reviewed the proposed changes and the public comments sent to EPA on this issue and decided to retain the requirement to use SW-846 methodologies in Washington's *Dangerous Waste Regulations* (Chapter 173-303 WAC).

Delegated states like Washington are not required to adopt less stringent changes to RCRA but may retain existing requirements. All retained SW-846 Test Methods are discussed in Chapter 3.

In addition, several other changes were reviewed, some of which were accepted and placed into the *Dangerous Waste Regulations*. Changes pertinent to this document, which were not accepted, include changes to 40 CFR 264 Appendix IX requirements. Therefore, the original Appendix IX table is retained and is incorporated in Appendix 5 of this document.

Chapter 1 Endnotes

1. As used in this manual, the words “dangerous waste” will refer to full universe of wastes regulated by Chapter 173-303 WAC. The abbreviation “DW” will refer only to that part of the regulated universe, which is not extremely hazardous waste (EHW).
2. See 40 CFR 268.40.
3. Book designation is only possible when a generator has sufficient knowledge of waste. The generator must understand the process that created the waste to identify the constituents of concern. More information on book designation can be found in WAC 173-303-100.

Chapter Two

Dangerous Waste Designation

2.1 Dangerous Waste Characteristics: WAC 173-303-090

2.1.1 Ignitability

2.1.1.1 Introduction

The ignitability characteristic identifies wastes that either present a fire hazard during routine storage, disposal, and transportation or, once started, feed the fire. Most ignitable wastes are liquids. Solids, ignitable compressed gases, and oxidizers may also create ignitability hazards.

Liquids and solids do not typically burn. They give off vapors that ignite only with air or another oxidizer. Some ignitable liquids give off insufficient vapor to burn at room temperature. The liquid must be heated before the vapor can ignite. The vapor will usually concentrate at or just above the surface of the liquid or solid.

2.1.1.2 Definition of Flashpoint

The United States Department of Transportation (USDOT) defines the flashpoint as,
"The minimum temperature at which a substance gives off flammable vapors which, in contact with sparks or flame, will ignite."

In other words, the flashpoint is the lowest temperature at which a liquid gives off enough vapor to ignite. A substance does not burn continuously at its flashpoint; the ignitable mixture only momentarily flashes. Flashpoints are determined using special equipment described in SW-846 Methods 1010 and 1020A (See Chapter 3). These methods can be found on the web at *www.epa.gov/epaoswer/hazwaste/test/main.htm*.

2.1.1.3 Oxidizers

An oxidizer can also be an ignitable waste. Oxidizing agents are powerful chemicals. They readily react with a large group of other substances. See section 1.1.4.4 of this chapter for the regulatory definition, as defined by WAC 173-303-090 (5) (a) (iv).

2.1.1.4 Regulatory Definition; Ignitable Characteristic

The following definitions are from the *Dangerous Waste Regulations* (WAC 173-303-090). Department of Transportation (DOT) regulatory definitions associated with the ignitable characteristic can be found in Appendix 2. However, the dangerous waste regulatory definition must be used for waste designation purposes, not the DOT definition.

2.1.1.4.1 Ignitable Liquids

An ignitable liquid is a liquid, other than an aqueous solution containing less than 24 percent alcohol by volume, and has a flash point less than 60° C (140° F), as determined by a Pensky-Martens Closed Cup Tester, using the test method specified in ASTM Standard ((D-93-06 (superseded by 08 revision)) or a

Setaflash Closed Cup Tester, using the test method specified in ASTM Standard (D3278-96 (2004)e1 as incorporated by reference at WAC 173-303-110 (3)(h)(v) and (vi). The test methods for determining flashpoint are addressed in Chapter 3.

2.1.1.4.2 Ignitable Solids

A solid waste is ignitable if:

It is not a liquid and is capable, under standard temperature and pressure, of causing fire through friction, absorption of moisture or spontaneous chemical changes and, when ignited, burns so vigorously and persistently that it creates a hazard (WAC 173-303-090 (5) (a) (ii)).

Examples of ignitable solids include metallic magnesium, metallic sodium, and white phosphorous.

2.1.1.4.3 Ignitable Compressed Gases

An ignitable compressed gas is a compressed gas as defined in WAC 173-303-090(5) (a) (iii). It must be flammable using test methods described in that regulation. Appendix 2B contains additional definitions, including the US DOT definition.

2.1.1.4.4 Oxidizers

As defined by WAC 173-303-090 (5) (a) (iv), an oxidizer is a substance such as a chlorate, permanganate, inorganic peroxide, or a nitrate, that yields oxygen readily to stimulate the combustion of organic matter. An organic compound containing the bivalent –O-O- structure and which may be considered a derivative of hydrogen peroxide where one or more of the hydrogen atoms have been replaced by organic radicals must be classed as an organic peroxide unless certain exceptions listed in the rule are met. Appendix 2C contains additional definitions including the DOT definition.

2.1.2 Corrosivity

2.1.2.1 Introduction

Corrosion refers to a chemical process in which metals and minerals are converted into undesirable by-products. Corrosion is caused by substances that eat into or destroy either metals or minerals, such as acids and bases. Furthermore, corrosion is not limited to metals and minerals alone. Corrosion also refers to the effects such substances have on human, plant or animal tissue.

Possible hazards associated with corrosive wastes include:

1. The spread of toxic metals if discharged into a landfill environment.
2. The destruction of handling, storage, transportation, and management equipment.
3. The destruction of human, animal, or plant tissue in the event of contact.

Chapter 173-303 WAC has identified two methods of determining whether or not a waste is corrosive. These methods[1] are pH determination and corrosivity toward Type SAE 1020 steel.

2.1.2.2 Definition of pH

The pH is a measure of the acidity or alkalinity of a solution. Aqueous solutions having a pH of 7 are neutral. The value increases with greater alkalinity and decreases with greater acidity. The greater the alkalinity (values greater than 7), the stronger the base. The lower the acidity (values lower than 7), the stronger the acid. Mathematically, pH is the negative logarithm of the hydrogen ion concentration in water.

2.1.2.3 Regulatory Definition; Corrosive Characteristic

A solid waste is corrosive if a representative sample has any of the following properties:

a. It is predominantly made of water and has a pH less than or equal to 2, or greater than or equal to 12.5, as determined by a pH meter using Method 9040C[2] in SW-846.

b. It is a liquid and corrodes steel (SAE 1020) at a rate greater than 0.250 inch (6.35 mm) per year at 55° C (130° F), as determined in Standard method TM-O1-69 from the National Association of Corrosion Engineers (NACE).

c. It is solid or semi-solid with a pH less than or equal to 2, or greater than or equal to 12.5 using Method 9045D in SW-846[3].

A corrosive solid waste is assigned one of two waste codes:

1. If a solid waste is corrosive using the methods ‘a’ or ‘b’ above, it is a dangerous waste (DW) and assigned the DW code of D002.
2. If a solid waste is corrosive using the method ‘c’ above, it is a DW, and assigned the DW code of WSC2.

2.1.3 Reactivity

2.1.3.1 Introduction

Wastes are reactive if they:

1. Readily undergo a violent chemical change.
2. React violently or form potentially explosive mixtures with water.
3. When mixed with water, generate toxic fumes or, in the case of cyanide- or sulfide-containing wastes, generate toxic fumes when exposed to mildly acidic or basic conditions.
4. Explode when subjected to a strong initiating force.
5. Explode at normal temperatures and pressures.
6. Fit within the Department of Transportation's forbidden explosives, Class 1 explosive; Division 1.1, Division 1.2, Division 1.3, and Division 1.5 explosives classifications[4].

These wastes require special handling because of their extreme instability and tendency to react violently or explode and because they pose a threat to human health and the environment at all stages of the waste management process.

2.1.3.2 Water Reactive Wastes

Water may react or interact with hazardous materials in a number of potentially dangerous ways. Water may react with a substance to form a product that is flammable, explosive, toxic, or corrosive. This process is called hydrolysis. Not all hydrolysis reactions result in products that have potentially dangerous properties.

Water may cause or aggravate a potentially hazardous situation in other ways. For instance, some substances absorb atmospheric water vapor, and are called hygroscopic. Two examples of hygroscopic substances are sodium hydroxide and concentrated sulfuric acid. A full container of concentrated sulfuric acid will overflow its container when left to stand in humid air.

2.1.3.3 Chemical Explosive Wastes

A chemical explosive is a substance that detonates spontaneously or as the result of friction, mechanical impact, or heat. Chemical explosives are distinguished from certain other substances, like gasoline or flammable gases, which may explode when confined in containers and ignited. They are also distinguished from nuclear explosives, which release energy from atomic reactions.

2.1.3.4 Regulatory Definition; Reactive Characteristic

A solid waste is reactive if a representative sample of the waste has any of the following properties:

1. It is normally unstable and readily undergoes violent change without detonating.
2. It reacts violently with water.
3. It forms potentially explosive mixtures with water.
4. When mixed with water, it generates toxic gases, vapors, or fumes which present a danger to human health or the environment.
5. It is a cyanide- or sulfide-containing waste which, when exposed to pH conditions between 2 and 12.5, can generate toxic gases, vapors, or fumes which present a danger to human health or the environment[5].
6. It is capable of detonation or explosive reaction if it is subjected to a strong initiating source or if heated under confinement.
7. It is readily capable of detonation or explosive decomposition or reaction at standard temperature and pressure[6].
8. It is a forbidden explosive, as defined in 49 CFR § 173.54[7], or a Class 1 explosive, Division 1.1, Division 1.2, Division 1.3, and Division 1.5, as defined in 49 CFR § 173.50

A reactive solid waste that meets any of the above conditions is a DW and assigned the code D003.

2.1.4 Toxicity Characteristic

2.1.4.1 Introduction

Toxicology is the study of adverse health effects caused by poisonous or toxic substances. Poisons or toxins generally cause or contribute to illness or death when administered to an organism in good health in relatively small amounts. The basic principles of toxicology are an important part of the study of hazardous materials.

In Washington State, toxic wastes are addressed in two ways; under the toxicity characteristic as determined by the Toxicity Characteristic Leaching Procedure (TCLP) or as a toxic dangerous waste under the dangerous waste criteria.

2.1.4.2 Toxicity Characteristic Leaching Procedure (TCLP)

TCLP was developed in an attempt to model the amount of dangerous waste compounds that would leach from a waste placed in a municipal solid waste landfill (dump). In a dump, the decomposing waste produces a slightly acidic leachate (pH 5.0). The acidic leachate extracts hazardous constituents from the waste, which then could migrate to ground water. Once in the ground water, the contaminants could migrate to an underground source of drinking water.

To establish limits for the toxicity characteristic, EPA's model assumed that the landfill leachate would be diluted by a factor of 100 before reaching a drinking water source. Therefore, toxicity characteristic (TC) concentration levels were established at 100 times drinking water standards. This is commonly referred to as the dilution attenuation factor, or DAR.

During TCLP, a subsample of a waste is extracted with an acetic acid solution for approximately 18 hours. This extract (the "TCLP extract") is then analyzed to determine if any of the waste thresholds have been exceeded[8]. Table 3.6[9] (Chapter 3) lists the regulatory thresholds for the 40 TCLP constituents and provides SW-846 methods for each constituent. Other methods may be equally reliable, but they must be approved by Ecology before they can be used to designate wastes.

2.1.4.3 Regulatory Definition; Toxicity Characteristic

A solid waste is toxic if, using the TCLP procedure, the extract from a representative sample of the waste contains any of the contaminants listed in the toxicity characteristic list in Table 3.6, at concentrations equal to or greater than the allowed limit. When the waste contains less than 0.5 percent solids, no extraction is necessary and the waste itself, after filtering, is analyzed directly.

Different dangerous waste codes are assigned depending on which compound is found in the waste. The waste codes for each compound is found in Table 3.6. Any waste that contains contaminants concentrations at or above the regulatory threshold must be designated DW and assigned a unique waste code.

2.2 Dangerous Waste Criteria: WAC 173-303-100

2.2.1 Introduction to State Criteria Wastes

The Environmental Protection Agency (EPA) regulates what is called hazardous waste (HW). EPA designates wastes as hazardous if they are found to be ignitable, corrosive, reactive, or toxic or they are a listed waste (F, K, P, U).

Washington State's environmental program, administered by Ecology, requires generators to evaluate their waste for additional requirements. Under Washington's *Dangerous Waste Regulations*, waste can designate as dangerous waste (DW) or extremely hazardous waste (EHW). Ecology has generally incorporated EPA's requirements verbatim as the state's dangerous waste designation method. In addition, Ecology chose to designate wastes, which fail certain criteria for fish or oral rat acute toxicity and persistence as dangerous waste. These are often referred to as "state-only" criteria to distinguish them from the federal requirements.

The state-only criteria depend on either analytical tests or knowledge about a waste and its contents. The generator is responsible for determining whether the waste does or does not meet the state-only criteria. EPA has no equivalent to these state-only criteria[10].

Generators may need to determine if a solid waste meets the state-only criteria. If a waste stream designates for any of the federal requirements, the generator, generally, does not need to evaluate state-only criteria. There are four circumstances[11] when a generator would need to do additional designation of waste already determined to be DW:

1. When a generator qualifies as a small quantity generator, the generator must determine if their DW is also designated as toxic EHW. There are added restrictions on EHW waste.

2. When a generator is discharging their DW waste to a Publicly Owned Treatment Works (POTW) operating under a permit-by-rule[12] the generator must determine if the waste is also an EHW. EHW waste cannot be sent to a POTW.

3. When the waste is used oil to be burned for energy recovery, the generator must determine if it also designates as a state-only DW. Used oil cannot be burned for energy recovery if it is EHW or contains PCBs above 2 ppm[13].

4. When the waste designates as a state-only DW and will be land disposed in Washington State, the generator must make sure the waste is not EHW and the state land disposal restrictions do not apply. EHW waste cannot be land disposed, except as provided by WAC 173-303-140, subsections (5), (6) and (7), and by provisions of RCW 70.105.050(2).

2.2.1.1 Background for Toxic Criteria Wastes

In 1978, during creation of the first dangerous waste regulations, Ecology included regulating dangerous waste toxic to mammals. Review of mammalian toxicity continues to be important to help prevent problems from waste not covered by the federal regulations. For mammalian toxicity, Ecology borrowed testing methods from the work used by the federal pesticide laws (Acute Oral Rat Toxicity Test).

Ecology was also concerned about toxicity to other parts of the environment. As seen with PCBs (polychlorinated biphenyls), chemicals can sometimes have a devastating effect on the environment. To address toxicity to non-mammals, Ecology included fish toxicity. Fish toxicity reflects the biological impact from waste components that, for the most part, can be dissolved in water. Other non-soluble portions of the waste, such as oils and particulate matter, can also significantly affect the outcome of the fish toxicity analysis. The fish used in this analysis will have fasted prior to the test. They also tend to be surface feeders and will eat floating material. In this way, the fish toxicity test approximates what may happen to waste dumped into a stream or lake.

Ecology developed the process to evaluate fish toxicity based on the work of the United Nations' Intergovernmental Maritime Consultative Organization (IMCO) and EPA's hazardous material spill regulations.

2.2.1.2 Background for Persistent Criteria Wastes

Ecology continues to wrestle with the problem of how to develop a system, which evaluates persistence. Initially, heavy metals, halogenated organic compounds, and aromatic hydrocarbons were designated as persistent compounds because of their possible genetic effects. To avoid regulating low concentrations and meet statutory requirements[14], Ecology decided that wastes must contain a certain concentration of polycyclic aromatic hydrocarbons (PAH) or halogenated organic compounds (HOC) to be persistent wastes.

For PAHs, the waste would designate as EHW if the total concentration of PAHs in the waste is greater than 1.0 percent (10,000 ppm). PAHs wastes only designate as EHW and are given a waste code of WP03. There is no level that would cause a waste containing PAHs to be DW.

HOC wastes with total concentration greater than 100 ppm (greater than 0.01 percent) would be DW waste and given a WP02 waste code. Wastes greater than 1.0 percent HOC content (10,000 ppm) would be EHW and given a WP01 waste code.

2.2.2 Acute Toxicity

2.2.2.1 Introduction

Both fish and mammalian toxicity are an indication of negative biological impact. Although toxicity criteria are biological in nature, generators may also choose to use chemical testing for waste streams with known constituents. In this circumstance, chemical tests are valuable in determining the chemical concentration, which can be used in referencing levels of toxicity for book designation. *See Chapter 3 (Section 3.7), "Methods to Determine State*-*only Waste."*

2.2.3 Persistence (Chronic Toxicity)

2.2.3.1 Introduction

Organic compounds, such as heating and motor fuels, cleaning solvents, paints, varnishes, and aerosols are very commonplace materials. From a safety perspective, the principal hazards of organic compounds are that they are frequently toxic, flammable, or may achieve explosive limits in the air. From an environmental perspective, the primary hazard of organic compounds is their ability to cause a range of detrimental chronic health effects. This hazard, combined with an organic compound's ability to persist in the environment has led to regulatory standards in Chapter 173-303 WAC.

2.2.3.2 Definition of Persistence and Half-life

In Washington State, a waste designates as a dangerous waste if it meets the definition of persistence[15]. Persistence has the following characteristics:

> **<u>Persistence</u>** is the ability of a chemical substance to remain in the environment in an unchanged form. The longer a chemical persists, the higher the potential for human or environmental exposure. The individual environmental media for which a chemical's persistence is usually measured or estimated are soil, sediment, and water[16].
>
> For the purposes of this document, a compound is considered persistent if:
>
> - It meets Ecology's definition of either a polycyclic aromatic hydrocarbon (PAH) or halogenated organic compound (HOC).

It meets the half life criterion of retaining more than half of its initial activity after one year (365 days) in either a dark anaerobic or dark aerobic environment at ambient conditions. Definition of half-life:

> **<u>Half-life</u>** is the length of time it takes for the concentration of a substance to be reduced by one-half relative to its initial level, assuming first-order decay kinetics.
>
> Generators are not required to analyze a waste to determine whether it retains more than half of its initial activity after two months (60 days). Instead, generators are required to identify specific persistence compounds. Those persistence compounds are either PAHs or HOCs. Chapter 173-303 WAC identifies these two classes of persistent organic chemical compounds due to the fact that they present a long-term threat because of bioaccumulation or present a chronic threat to human health and the environment.

2.2.3.3 Definition of Halogenated Organic Compounds (HOC) and Polymer

For the purpose of this document, an **HOC** is defined as any organic compound, which includes at least one atom of fluorine, chlorine, bromine, or iodine bonded directly to a carbon atom.
The carbon-halogen bond is one of the primary organic structures that resist biodegradation in the environment. Some examples of chemicals not intended to be regulated as HOC are halide salts like the hydrochlorides, the sulfonyl chlorides, and other classes of compounds where the halide is not bound to a carbon atom. Examples of compounds that are and are not HOCs can be found in **Sections 3.8.6.1 and 3.8.7.** In addition, HOCs, which are polymerized or chemically bound in a solid matrix are not subject to regulation under WAC 173-303-100.

For the purpose of this document, a **polymer** is defined as a long, repeating chain formed from organic molecules via the linkage of many smaller molecules called monomers. A key feature that distinguishes polymers from other large molecules is the repetition of smaller units (monomers) in their chain. The process of linking the smaller units (monomers) together is called polymerization.

A polymer must meet the following criteria:

- Consist of 100 or more repeating units (monomers) with at least one halogenated compound in the monomer combined together into a single chain;
- Having a number average molecular weight of at least 5,000.

Additives are often combined with polymers to produce specific properties and are not included in the definition of polymer. By additives, Ecology means chemicals which are mixed with the polymer to provide some specific characteristic. An example of an additive is flame retardants which are often added to polymers to slow burning. These flame retardants are often not chemically bonded to the polymer but are mixed with the polymer and formed into a product. Additives and polymers with additives must be evaluated for persistence. For more information, see **Chapter 3, Section 3.8.7.3**

2.2.3.4 Definition of Polycyclic Aromatic Hydrocarbons (PAH)

For the purpose of this document, a **polycyclic aromatic hydrocarbon** is defined as a class of compounds composed of two or more fused benzene rings.

PAHs are defined in the regulations through a specific list of chemicals. There are twenty PAHs of concern under current *Dangerous Waste Regulations*:

- Acenaphthene
- Acenaphthylene
- Anthracene
- Benzo(a)anthracene
- B enzo(a)pyrene
- Benzo(b)fluoranthene
- Benzo(g,h,i)perylene
- Benzo(k)fluoranthene
- Chrysene
- Dibenzo(aj) acridine
- Dibenzo(a,h)anthracene
- Dibenzo(a,e)pyrene
- Dibenzo(a,h)pyrene
- Diberizo(a,i)pyrene
- Dibenzo(a,1)pyrene
- Fluoranthene
- Fluorene
- Indeno(1,2,3-c,d)pyrene
- Phenanthrene
- Pyrene

2.2.3.5 Regulatory Definition; Criteria of Persistence

Persistent constituents are chemical compounds which are either halogenated organic compounds (HOC), or polycyclic aromatic hydrocarbons (PAH)[17]. A generator may determine the identity and concentration of persistent constituents by either applying knowledge of the waste or by testing the waste[18].

1. The waste is not designated for persistence if a generator only knows:
   - Some of the persistent constituents in the waste.
   - Some of the constituent concentrations.
   - If the waste is not designated for those known constituents or concentrations.

2. When a waste contains HOCs for which the concentrations are known, the total HOC concentration must be determined by summing all HOC concentrations. Any waste that contains more than 100 ppm (0.01%) total HOCs is a state-only persistent DW and more than 10,000 ppm (1.0%) is a state-only persistent EHW (see table below).

3. When a waste contains PAHs for which the concentrations are known, the total PAH concentration must be determined by summing all PAH concentrations. Any waste that contains more than 10,000 ppm total PAHs is a state-only persistent EHW (see table below).

Table 2.1 Persistent Dangerous Waste

If your waste contains	At a total concentration level of	Then your waste's designation and waste number are
Halogenated Organic Compounds (HOC)	• 0.01 percent to 1.0 percent • Greater than 1.0 percent	• DW, WP02 • EHW, WP01
Polycyclic Aromatic Hydrocarbons (PAH	• Greater than 1.0 percent	• EHW*, WP03
*No DW concentration level for PAH		

Chapter 2 Endnotes

1. These methods are addressed in Chapter 3.
2. Find SW-846 Method 9040C at *www.epa.gov/epaoswer/hazwaste/test/main.htm*. Ecology regional offices can also provide a copy.
3. Find SW-846 Method 9045D at *www.epa.gov/epaoswer/hazwaste/test/main.htm*. Ecology regional offices can also provide a copy.
4. Find Department of Transportation (DOT) Regulations - 49 CFR at: *www.access.gpo.gov/nara/cfr/waisidx_06/49cfr173_06.html*
5. See Chapter 3.7 (Analysis for the Reactivity Characteristic).
6. With standard temperature being 20° C and standard pressure being 760 mm of Hg (1 atm).
7. 49 CFR is available at: *www.access.gpo.gov/nara/cfr/waisidx_06/49cfr173_06.html*.

8. WAC 173-303-090 (8); *www.epa.gov/epaoswer/hazwaste/test/main.htm*.
9. See Chapter 3.5 of this document for methods for determining toxicity.
10. As described in WAC 173-303-100 through WAC 173-303-104 (3).
11. Although EPA does not have a regulatory counterpart for criteria waste, EPA does use acute toxicity and persistence as the basis for listing a waste.
12. WAC 173-303-802.
13. Any waste containing PCBs above 50 ppm are regulated under federal Toxic Substance Control Act (TSCA).
14. RCW requirement of short-term effects (RCW 70.105.010 (a)).
15. For regulatory definition, see WAC 173-303-040.
16. WAC 173-303-040.
17. AS defined under WAC 173-303-040.
18. Except as provided for in WAC 173-303-070 (4) or (5).

Chapter Three

Analytical Test Methods for Designating Dangerous Waste

3.1 Introduction

This chapter addresses procedures for required method-defined parameters, where the analytical result is only dependent on the process used to make the measurement. Changes to the specific methods may change the end result and incorrectly identify a waste as non-hazardous.

Methods for determining the characteristics of ignitability for liquids, corrosivity for liquids, and toxicity are included in method-defined parameters. The complete procedure for the listed test methods in this chapter is on the Web at: www.epa.gov/epawaste/hazard/testmethods/index.htm.

Not all test methods accepted by Ecology are included in this document. Some test methods are referenced due to copyright restrictions (e.g., ASTM) or length (e.g., EPA analytical methods). Therefore, to be uniform and consistent, this document uses primarily the EPA publication *Test Methods for Evaluating Solid Waste -Physical/Chemical Methods; SW-846*. EPA publishes the most current revision on the Web at: www.epa.gov/epaoswer/hazwaste/test/main.htm.

Washington State continues to require SW-846 methods for designation analyses in accordance with WAC 173-303-110 unless otherwise specified. You can obtain a copy of any method by either contacting your local regional office (see inside the front cover of this document) or visiting Ecology's Web site (www.ecy.wa/ecyhome.html).

Certain methods are specifically required by the regulations. For example, specific methods are required for characteristic wastes and to determine free liquid for LDR regulations. When methods are not specified, any approved method (see list below) may be used for hazardous waste testing. In these cases, the analytical method chosen by the generator must provide enough information to make the regulatory decision. In selecting a method, the generator must choose a method which:

- Identifies all compounds of concern in the waste.
- Is sensitive enough to meet the regulatory level.
- Is appropriate for the sample matrix, i.e., solid, liquid, soil, waste, etc.
- Provides sufficient accuracy and precision.

Because a waste can be liquid, solid, or gaseous, several standardized methods are available other than SW-846. Ecology recognizes methods from the following sources for non-regulatory requirements that were not specified in WAC 173-303-110[1a] :

1. *Standard Methods for the Examination of Water and Wastewater*, most current edition.
2. *Methods for Organic Chemical Analysis of Municipal and Industrial Wastewater*, EPA.

3. *600/4-79-020*, EPA.
4. National Association of Corrosion Engineers.
5. The American Society for Testing and Materials (ASTM).
6. Air Pollution Training Institute (APTI), National Technical Information Service.

Using these alternatives, a generator can choose a method that is matrix-specific and precise enough to provide the information necessary to make a decision. Therefore, the generator of the waste should consult with their analytical laboratory on which analysis best meets their needs. Ecology strongly recommends the use of accredited laboratories[1b], which is an indicator of the quality of a lab's work. The generator should show caution when making these choices. If a waste is designated or disposed of incorrectly, the generator remains legally liable for any cleanup costs.

Other methods may be equally reliable, but these methods must be approved by Ecology before they can be used to designate waste.

3.2 Methods for Determining Flashpoint

Methods 1010A and 1020B[2] use a closed cup tester to measure flashpoint. The closed cup analyses are appropriate only for liquids. Do not use this method with solids.

Although no specific definition for "liquid" exists, EPA has provided some guidance. SW-846 Method 9095B, the paint filter liquids test, has traditionally been used to determine whether a waste contains liquids for other regulatory requirements[3]. Method 9095B is used to determine compliance with 40 CFR 264.314 and 265.314. If any liquid seeps through the filter, it is considered a liquid. Therefore, samples of some wastes, like sludge, might demonstrate the presence of free liquids in the paint filter test and should be tested for ignitability.

EPA produced guidance to address this issue in January 13, 1995[4].

> *"The **definitive procedure** for determining if a waste contains a liquid for the purposes of the ignitability and corrosivity characteristics is the **pressure filtration technique specified in Method 1311.”***

However, if one obtains liquids using Method 9095B, it should be assessed for ignitability or corrosivity using the pressure filtration technique in Method 1311.

To determine ignitability, the test liquid is placed into a small closed container and an ignition source supplied. If the test liquid flashes (ignites), the waste is ignitable. Waste liquids are dangerous wastes if their flashpoint is less than 140° F using the methods specified in WAC 173-303-090 (5)[5] or in SW-846 (*www.epa.gov/epaoswer/hazwaste/test/main.htm.*)

The regulations include a special exemption for wastes containing alcohol called the "alcohol exclusion." When an aqueous waste contains less than 24 percent alcohol but is still ignitable because of the alcohol content, a generator need not designate this waste as ignitable. "Alcohol" refers to any alcohol or combination of alcohols. The alcohol exclusion exempts alcoholic beverages and some types of latex paints, which exhibit low flashpoints due to the alcohol but do not flash because of the high water content.

While the concept of flashpoint is useful for describing the ignitability of liquids, the term does not ordinarily have meaning when applied to ignitable gases or solids. At room temperature, most ignitable gases do not need to be heated to ignite. Therefore, other wastes, in addition to liquids, must be designated as ignitable if they meet the definition.

3.3 Methods for Determining Corrosivity Towards Steel

Chapter 173-303 WAC has identified two methods of determining whether or not a waste is corrosive. These methods are pH determination and corrosivity toward Type SAE 1020 steel. SW-846 method 1110A measures the corrosivity towards steel of both aqueous and non-aqueous liquid waste. Find SW-846 Method 1110A at: *www.epa.gov/epaoswer/hazwaste/test/main.htm*[6].

3.4 Methods for Determining pH

A common method of determining pH is by using pH testing papers. The pH of a waste can be approximated with wide-range pH paper. Litmus is probably the most commonly used wide range pH paper. When moistened with an aqueous acid, litmus paper turns red; when moistened with a basic solution, it turns blue. More accurate pH determinations can be made using "narrow-range" pH paper whose accuracy has been determined (1) using a series of buffers, or (2) by comparison with a calibrated pH meter.

Although narrow-range pH paper can be purchased with a distinct color change for every 0.5 pH unit, pH paper is not as accurate as pH meters. For this reason, pH paper cannot be used to designate definitively whether a waste is corrosive or non-corrosive. However, narrow pH paper can be used to confirm knowledge about a waste. In a chemical laboratory, the pH is typically determined using a pH meter. A pH meter is a voltage-measuring device attached to a pair of electrodes. When the tips of the electrodes are placed in a solution, the pH of the solution shows on the meter. The pH meter is calibrated using predetermined standards.

pH readings are only applicable for aqueous solutions. Wastes with greater than 20 percent water should be tested using SW-846 Method 9040C[7]. Wastes with less than 20 percent water are considered solid or semi-solid wastes, and should be analyzed using SW-846 Method 9045D.

SW-846 Method 9045D[8] analyzes solid or semi-solid wastes for corrosivity[9]. Wastes with 20 percent or less water are mixed with an equal weight of water. After the solids have settled, the liquid portion will be tested using a pH meter. It is important to note that for these types of waste, the liquid portion is not decanted off and analyzed for pH. Testing for pH must be done by an approved SW-846 method if it is being used for waste designation purposes.

3.5 Analysis for the Reactivity Characteristic

See Chapter 2 for the regulatory definition of reactive characteristic.

EPA currently has no required test methods for reactive waste as defined in 40 CFR 261.23 for any of the reactive characteristics. Therefore, generators must use waste knowledge to determine if their waste exhibits the characteristic of reactivity. The interim *Guidance for Reactive Cyanide and Reactive Sulfide in Waste* found in Appendix 3 of the draft *2007 Chemical Testing Methods for Designating Dangerous Waste* (WAC 173-303-090 &100) has been withdrawn (See Appendix 4).

Until a revised guidance is developed by EPA, Ecology reiterates the regulatory language in 40 CFR 261.23(a)(5), which specifies that human health and the environment must not be endangered by evolved toxic gases when these wastes are exposed to pH conditions between 2 and 12.5. Any waste causing a hazard, when in the pH range of <2 and >12.5, would be considered a characteristic hazardous waste. Where wastes with high concentration of soluble sulfides and cyanides are being managed, generators have relied on their knowledge of the waste to classify them as D003.

ASTM D4978-95(2007)[10] test methods are applicable to the screening of reactive sulfides in wastes, liquids, sludge's, semisolids, and solids. These test methods are not applicable in determining the type and concentration of reactive sulfides. These test methods are designed and intended to complement quantitative analytical techniques that may be used to determine sulfide concentration. These test methods offer the user the ability to screen waste for potentially hazardous levels of reactive sulfide when the quantitative analytical techniques are not available and the total waste composition is unknown.

3.6 Methods for Determining Toxicity

The Toxicity Characteristic Leaching Procedure (TCLP) was established by EPA in 1990. SW-846 Method 1311 evaluates the leachability of forty compounds in Table 3.6. The complete procedure is found on the Web at *www.epa.gov/epaoswer/hazwaste/test/main.htm*. The TCLP consists of five steps, which are summarized below. For complete details, please review the full method.

3.6.1 Separation Procedure

For liquid waste (those containing less than 0.5 percent dry solid material), the TCLP extract is the liquid portion of the waste after filtration. For wastes with greater than or equal to 0.5 percent solids, any liquid is separated from the solid phase and stored for later analysis.

3.6.2 Particle Size Reduction

Prior to extraction, the solid material must be reduced in size so it can pass through a 9.5-mm (0.375-in.) standard sieve, have a surface area equal to or greater than 3.1 cm^2, or be smaller than 1 cm in its narrowest dimension. If the waste does not meet these requirements, the solid portion is crushed, cut, or ground until these conditions are met. (Special precautions are necessary for organic volatiles extraction.)

3.6.3 Extraction of Solid Material

Once the size restrictions are met, the solid material is mixed with an amount of extraction fluid equal to 20 times the weight of the solid phase. The mixture is extracted for approximately 18 hours. A special extractor vessel is used when testing for volatile analytes.

3.6.4 Final Separation of the Extraction from the Remaining Solid

Following extraction, the liquid phase is separated from the solid phase by filtration. If compatible, any liquids separated before extractions are added and the two are analyzed together. If incompatible, the liquids are analyzed separately and the results are mathematically combined to yield an average concentration.

3.6.5 Testing (Analysis) of TCLP Extract

Inorganic and organic species are identified and quantified using methods in the 6000, 7000, and 8000 series of SW-846 methods in this manual or by other appropriate or equivalent methods[11].

Different dangerous waste codes are assigned depending on which compound is found in the waste. The waste codes for each compound is found in Table 3.6. Any waste that contains contaminant concentrations at or above the regulatory threshold must be designated DW and assigned a unique waste code.

Table 3.6: Maximum Concentration of Contaminants for the Toxicity Characteristic

Dangerous Waste Code	Contaminant	Chemical Abstracts Services #	Regulatory DW Level (mg/L)	SW-846 Test Methods after 1311
D004	Arsenic	7440-38-2	5.0	6000 or 7000 series
D005	Barium	7440-39-3	100.0	6000 or 7000 series
D018	Benzene	71-43-2	0.5	8021B, 8260B
D006	Cadmium	7440-43-9	1.0	6000 or 7000 series
D019	Carbon tetrachloride	56-23-5	0.5	8021B, 8260B
D020	Chlordane	57-74-9	0.03	8081A, 8270
D021	Chlorobenzene	108-90-7	100.0	8021B, 8260B
D022	Chloroform	67-66-3	6.0	8021B, 8260B
D007	Chromium	7440-47-3	5.0	6000 or 7000 series
D023	o-Cresol	95-48-7	200.0[1]	8270C
D024	m-Cresol	108-39-4	200.0[1]	8270D
D025	p-Cresol	106-44-5	200.0[1]	8270D
D026	Cresol		200.0[1]	8270D
D016	2,4-D	94-75-7	10.0	8151A
D027	1,4-Dichlorobenzene	106-46-7	7.5	8021B, 8260B
D028	1,2-Dichloroethane	107-06-2	0.5	8021B, 8260B
D029	1-1-Dichloroethylene	75-35-4	0.7	8021B, 8260B
D030	2,4-Dinitrotoluene	121-14-2	0.13	8270C
D012	Endrin	72-20-8	0.02	8081A,8085, 8270
D031	Heptachlor (and its epoxide)	76-44-8	0.008	8081A, 8085, 8270
D032	Hexachlorobenzene	118-74-1	0.13	8081A, 8121, 8270C
D033	Hexachloro-1,3-butadiene	87-68-3	0.5	8021B, 8260B
D034	Hexachloroethane	67-72-1	3.0	8270CD
D008	Lead	7439-92-1	5.0	6000 or 7000 series
D013	Lindane	58-89-9	0.4	8081A, 8270
D009	Mercury	7439-97-6	0.2	6000 or 7000 series
D014	Methoxychlor	72-43-5	10.0	8270D, 8081A
D035	Methyl ethyl ketone	78-93-3	200.0	8260B, 8261
D036	Nitrobenzene	98-95-3	2.0	8270D
D037	Pentachlorophenol	87-86-5	100.0	8270D
D038	Pyridine	110-86-1	5.0	8270D
D010	Selenium	7782-49-2	1.0	6000 or 7000 series
D011	Silver	7440-22-4	5.0	6000 or 7000 series
D039	Tetrachloroethylene	127-18-4	0.7	8021B, 8260B
D015	Toxaphene	8001-35-2	0.5	8081A, 8270
D040	Trichloroethylene	79-01-6	0.5	802113, 8260B
D041	2,4,5-Trichlorophenol	95-95-4	400.0	8270D
D042	2,4,6-Trichlorophenol	88-06-2	2.0	8270D
D017	2,4,5-TP (Silvex)	93-72-1	1.0	8151A, 8321, 8085
D043	Vinyl chloride	75-01-4	0.2	8021B, 8260B

[1] *If o-, m-, and p-cresol concentrations cannot be differentiated, the total cresol (D026) concentration is used.*

3.7 Methods to Determine State-only Toxic waste

There are three methods generators can use to determine if their waste is a state-only toxic:

1. Book designate using product information.
2. Use chemical tests in conjunction with book designation.
3. Biologically test the waste for toxicity.

When a generator chooses to book designate waste, he/she must follow the book designation procedure as outlined in WAC 173-303-100 (5) (b). Book designation is a very common procedure for toxic wastes[12]. The generator applies existing knowledge of the various chemical constituents of the waste stream. This knowledge could be gained using a combination of tools such as:

- Material Safety Data Sheets (MSDSs).
- An understanding of reaction, concentration, or dilution effects associated with the production- process, and supplemented (if necessary) with testing data.

Ecology could require testing if there is reason to believe a waste has been improperly designated (WAC 173-303-070 (4)).

The generator could choose to determine the actual concentration of the various chemicals in the waste stream using any of the approved test methods in the regulations (WAC 173-303-110). With this chemical information, the generator is required to determine the toxic category for each known constituent. The toxic category for each constituent may be determined by obtaining data from three sources:

1. The National Institute for Occupational Safety and Health's (NIOSH) Registry of Toxic Effects of Chemical Substances (RTECS), Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402.
2. The United States Environmental Protection Agency, Ecotoxicology database (ECOTOX), Mid-Continent Ecology Division, 6201 Congdon Boulevard, Duluth, MN 55804.
3. The United States National Library of Medicine Toxicology Data Network, Hazardous Substance Database (HSDB), 8600 Rockville Pike, Bethesda, MD 20894.

The generator may choose to test the waste according to *Biological Testing Methods,* Ecology publication #80-12, (the most current revision), instead of using the book designation procedure. Either of these procedures are accepted in Washington State.

3.8 Test Methods for Determining Halogenated Organic Compounds

When a waste contains one or more Halogenated Organic Compounds (HOC), the total HOC concentration must be determined by summing the concentration for all HOCs for which the concentration is known. If the total known concentration of HOCs exceeds 100 parts per million (ppm), the waste would then designate as DW and be assigned a waste code of WP02. If the total known concentration of HOC exceeds 10,000 ppm, the waste would designate as extremely hazardous waste (EHW) and be assigned a waste code of WP01.

It is very important for generators to understand that a wide range of halogenated organic compounds may cause a waste to designate as persistent waste. Unfortunately, there is no single analytical method that will clearly identify all potential HOCs regulated in Washington State.

Generators should be aware that halogenated organic compounds are also found in other parts of the regulations. For example, the toxicity characteristics list contains twenty-three halogenated organic (chlorinated) compounds, over fifty percent of the forty substances to be determined under TCLP. In addition, spent halogenated organic solvents are identified in the "F" list and others are in the "U" and "P" lists of compounds.

Also, when used oil is burned for energy recovery, it is presumed to be dangerous waste if it contains more than 1,000 ppm total halogens. However, under most circumstances, a waste that is not identified as dangerous waste under any of these characteristics, lists, or other criteria must still be evaluated for persistence, including used oil that is to be burned for energy recovery or sent for land disposal.

Because of the potential for a wide range of halogenated organic compounds to be in waste streams produced by generators, generators often don't know the type of HOC's or their concentration in their waste streams. When knowledge of the waste is insufficient, Ecology recommends that the generator rely on their analytical laboratory for the appropriate analytical method to determine the HOC content in their specific waste stream. WAC 173-303-070(3)(c)(ii) describes when knowledge can be used for waste designation.

The following test methods are recommended for use in the determination of whether a waste would designate as persistent for HOCs where the HOCs concentration in the waste is unknown. Please note that SW-846 contains many methods not mentioned in this document that could satisfy the requirements of this chapter. If a generator knows or suspects the constituents in their waste stream would not be identified by the methods specified below, they must consult their analytical laboratory for the appropriate SW-846 test method.

3.8.1 Evaluation Methods for Determining HOCs

HOC concentration levels are based on the whole compound; both the organic base and the associated halogen portion. Halogens can be substituted on an organic base from 0.01 percent to 90 percent. Ecology has determined a need for assistance on designating a waste using only the halogen portion of the HOC.

3.8.2 HOCs as Halogens

Ecology based its designation of state-only persistence criteria on the pattern of existing Ecology and EPA guidance, specifically the *Special requirements for used oil burned for energy recovery* rule. This rule was chosen as representative due to the type of waste streams that are currently being designated as persistent waste. They are:

- halogenated solvent solids
- grease
- solids contaminated with grease
- tar and heavy petroleum distillates
- waste and used oils
- used solvent
- used oil contaminated with 1,1,1-trichloroethane
- parts washer solvent

Most of these wastes are typical of the types of wastes that go for fuel blending. Therefore, the concentration levels for HOCs were matched with the concentration level that has been established for total halogens in waste oils.

3.8.3 Evaluation of Wastes for HOCs based on Total Organic Halogens

Ecology established general evaluation criteria**,** which can be used to determine if a waste designates as an HOC based on the total organic halogen content of the waste stream provided the HOC concentration in the specific waste stream is unknown. If the total halide concentration of the waste exceeds 100 ppm (mg/L or mg/kg) regardless of the chemical composition of the waste, the waste designates as state-only persistent and must be assigned the appropriate waste code and disposed of as required to a permitted facility[13].

The evaluation analysis strips any halogen from its source compound and determines only the total concentration of the halides in the waste stream. Based on the analyses Ecology conducted in preparation of this change, it was possible to determine an approximate correlation factor of 10 between the halide concentration determined by the general evaluation method and the HOC concentration in the waste determined by the testing method.

The following criteria must be followed to determine waste properties properly under the evaluation method:

1. Determine the total concentration of halides in the waste stream. If the waste contains a total halide concentration at the following levels:

Table 3.8.3: Designation Waste Concentrations and Resulting Dangerous Waste Codes

For a concentration level of….	The waste designation numbers are….
100 to 10,000 ppm	DW, WP02
Greater than 10,000 ppm	EHW, WP01

2. Wastes containing halogens at the concentration levels specified are presumed to be a dangerous waste because those halogens are organic. If the waste is determined to be a persistent dangerous waste based on the evaluation analysis, the generator can, if he chooses, conduct further analyses to prove the waste is not persistent. This proof can only be done by providing documented evidence that:

   A significant portion of the total halide concentration is due to inorganic halogens. As noted earlier, inorganic halogens are not HOCs and are not regulated as persistent compounds. The proof must be supported by clear evidence that the waste contains non-persistent components and that these components provide an overwhelming majority of the halogens identified in the general evaluation analysis.

   Note[1 a-b]: If the evaluation for total organic halide analysis indicates the waste stream designates as EHW (halide concentration greater than 10,000 ppm), the generator may conduct further analyses to prove the waste is not an EHW but is in fact a DW

If the generator has knowledge of the specific HOCs present in the waste, they should be able to calculate the quantity of HOCs.

3.8.4 Evaluation Methods

Ecology recommends that either SW-846 Method 9023 or Methods 5050 and 9056 be used in the determination of halide concentration in a waste stream.

EPA Method 9023, Extractable Organic Halides (EOX) in Solids may be used for the determination of total extractable organic halides (EOX) in solid waste. Extractable organic halides containing chlorine, bromine, or iodine are detected. The laboratory should determine the suitability for extraction with ethyl acetate for specific known halides in a waste stream or use other extraction solvents if extraction with ethyl acetate results in low or no recovery.

Ecology recognizes the following limitations with Method 9023:

- Fluorine containing species are not detected by this method.
- Polybrominated diphenyl ether (PBDE) such as Deca-BDE has limited solubility in organic solvent and may not be suitable for extraction with ethyl acetate.

Method 9056, Determination of Inorganic Anions by Ion Chromatography works well for aqueous waste streams. (Note: Organics in your waste can seriously affect the functioning of an ion chromatograph. Check with your laboratory if your waste contains organics.)

For solid waste samples, Method 9056 uses SW-846 Method 5050, Bomb Preparation Method for Solid Wastes. Method 5050 combusts the solid waste and converts the halogenated organics into carbon dioxide, water and fluoride, chloride, bromide or iodine inorganic species. These halogen inorganics are recovered and analyzed via Method 9056.

Ecology recognizes the following limitation with Method 5050:

- Samples with very high water content (>25%) may not combust efficiently and may require the addition of a mineral oil to facilitate combustion.

Ecology recognizes the following limitation with Method 9056:

- Method 9056 does not detect iodine but gives accurate results for chloride, bromide, and fluorine.

Ecology supports the use of Methods 9023 and 5050/9056 for the evaluation of a waste stream containing HOCs based on total organic halogens. These methods are available on the Web at:
http://www.epa.gov/epawaste/hazard/testmethods/sw846/index.htm
Ecology regional offices can also provide a copy of the method. See inside the front cover of this document for information on the closest regional office to you.

The total concentrations of chloride, bromide, and fluoride are compared against the regulatory limits identified in Table 3.8.3, to determine if the waste designates as a state-only persistent waste.

Although Ecology supports the use of SW-846 Methods 9023 and 5050/9056 for the determination of HOCs as halogens, other halogen specific analyses exist that could satisfy the evaluation criteria. These methods as in method 5050/9056 would not provide total organic halogen concentration. The individual organic halides would need to be summed up to get the total organic halogens in the waste stream. Table 3.8.4: Methods for Determining Halogens, lists some of the analysis methods described in SW-846.

Table 3.8.4 a: Alternative Evaluation Methods for the Determination of HOCs as Halogens

Method No.	Method Title
Method 9075	Test Method for Total Chlorine in New and Used Petroleum Products b X-Ray Fluorescence Spectrometry (XRF)
Method 9077	Test Methods for Total Chlorine in New and Used Petroleum Products (Field Test Kit Methods).
Method 9211	Potentiometric Determination of Bromide in Aqueous Samples with Ion-Selective Electrode
Method 9212	Potentiometric Determination of Chloride in Aqueous Samples with Ion-Selective Electrode
Method 9214	Potentiometric Determination of Fluoride in Aqueous Samples with Ion-Selective Electrode
Method 9250	Chloride (Colorimetric, Automated Ferricyanide AAI)
Method 9251	Chloride (Colorimetric, Automated Ferricyanide AAII)
Method 9253	Chloride (Titrimetric, Silver Nitrate)

If alternative methods other than those recommended by Ecology are used, the generator needs to obtain concentrations for all halides, which are then compared against the designation limits. None of the individual methods identified above provide the necessary information on all halide species to be able to sum individual concentrations of HOCs. Therefore, results from multiple methods will be needed.

If the chemical constituents of the waste stream are known, the generator must consult with their analytical laboratory to determine which test method will work best to determine the HOC content of their waste stream. Ecology recommends the use of the `8000 series' methods in SW-846. As with all of the 8000 series methods, e.g. 8021B and 8121, specific analytes are targeted. Although these methods have a limited target list associated with them, other compounds not listed may be able to be determined using these methods.

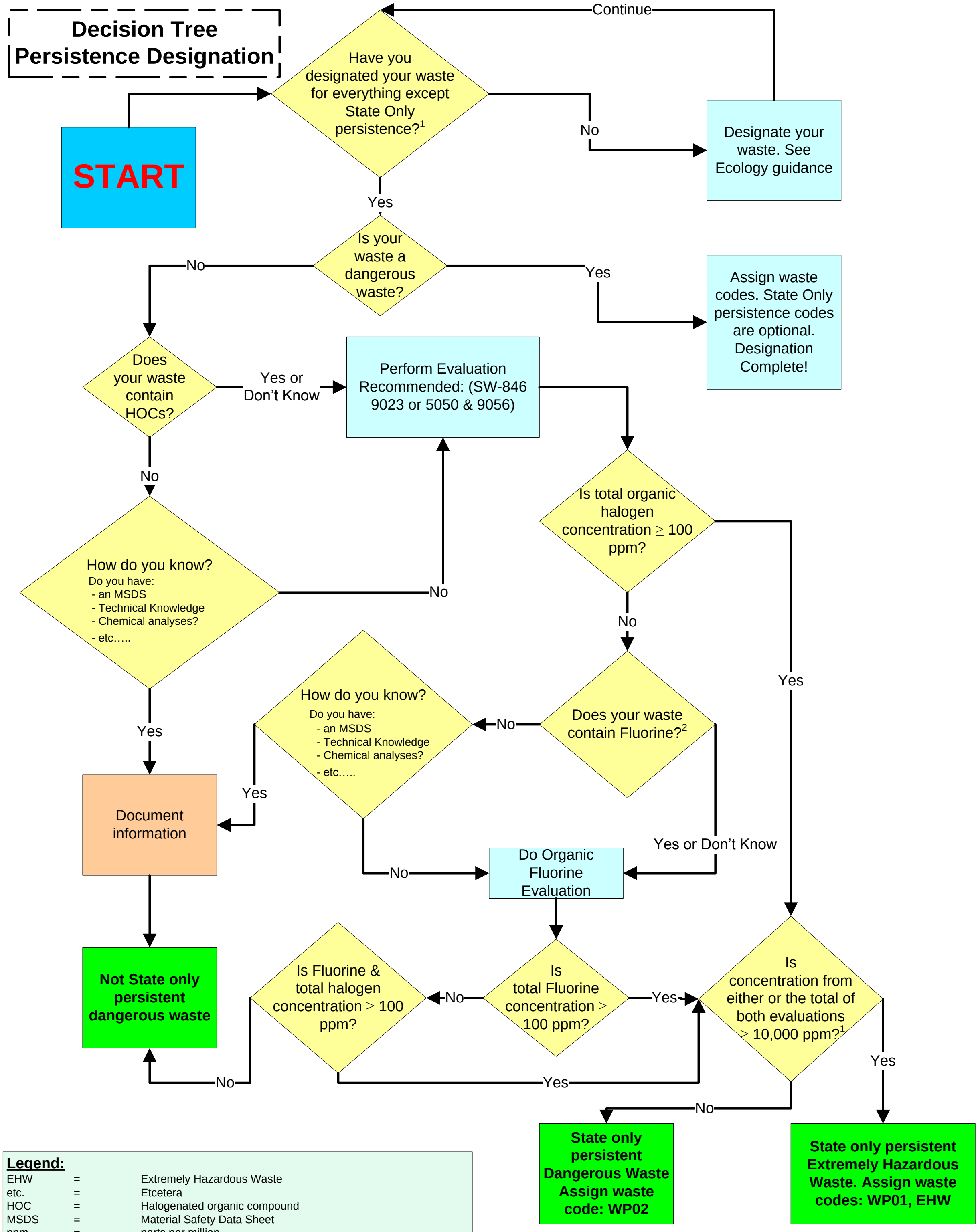
Table 3.8.4 b: Determinative Methods for Known HOCs

SW-846 Method No.	Analytes Detected
8021B	Halogenated Volatiles
8081A	Organochlorine Pesticides
8082	PCBs
8111	Haloethers
8121	Chlorinated Hydrocarbons
8151A	Chlorinated Herbicides
8260B	Volatile Organic Compounds
8270C	Semivolatile Organic Compounds

3.8.5 Designation Flow Chart

To assist in the designation process, Ecology formulated a decision tree, which documents the steps needed to designate wastes for state-only persistence. The decision tree represents the evaluation process using the methodology based on SW-846 Methods 9023 or Methods 5050 and 9056 run in combination. Method 9023 does not detect fluorine and Methods 5050/9056 does not detect iodine. These methods are not screening methods. Depending on the method (s) chosen, additional fluorine or iodine evaluation may be performed.

Decision Tree Persistence Designation



Legend:

EHW	=	Extremely Hazardous Waste
etc.	=	Etcetera
HOC	=	Halogenated organic compound
MSDS	=	Material Safety Data Sheet
ppm	=	parts per million
WP01	=	Washington State-only persistent EHW
WP02	=	Washington State-only persistent dangerous waste
>=	=	greater than or equal to
#	=	number

[1] Additional designation requirements exist for Small Quantity Generators, used oil, etc. and are not in included in this flow chart. See text for additional information on these waste streams

[2] Note: This evaluation is only needed if some other analysis is done other than the Methods 5050 and 9056 recommended as a General Evaluation. Alternatives usually do not include fluorine concentration.

3.8.6 Examples of Wastes That Need Not Be Evaluated for State-only Persistence

The following are provided as examples and are intended solely to clarify the definitions presented in above sections. These examples are not all encompassing but are intended to provide examples of types of compounds. If a generator is unsure whether his waste meets any of the following criteria he should contact his local Ecology office identified in the beginning of this document.

3.8.6.1 Compounds That Are Not HOCs

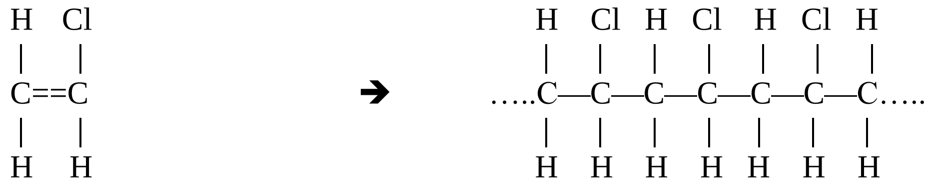
Ecology's definition of persistence requires a halogen to be directly bonded to a carbon atom. There are numerous compounds that contain halides which do not meet this definition. Examples of compounds that are **not** considered HOCs are:

1. Sodium chloride (also known as table salt): This compound is the major constituent in sea water and appears in many mixtures. As the chlorine atom is not connected to a carbon atom, it does not meet the definition of an HOC.
2. Ortho-Toluidine hydrochloride: This compound appears in EPA's Appendix IX list and was initially included for consideration. However, the halogen is not directly bonded to a carbon but exists as a chloride ion in solution with the compound. Therefore, it does not meet the definition of an HOC.
3. 4'-Nitro-biphenyl-4-sulfonyl chloride: This compound is an example of a sulfonyl chloride. In this compound, the chlorine atom is attached directly to the sulfur atom. Therefore, it does not meet the definition of an HOC (the chlorine atom is not connected to a carbon atom).

3.8.6.2 Polymers

As defined in section 2.2.3.3, compounds that meet Ecology's definition of a polymer are not considered state-only persistent wastes. Halogenated polymers are not evaluated for state-only persistence criteria because, although they persist for extended periods of time in the environment, they are resistant to decomposition and have little biological impact. Polyvinyl chloride (PVC) is an example of a halogenated polymer composed of many repetitions of the vinyl chloride monomer as in the following example:

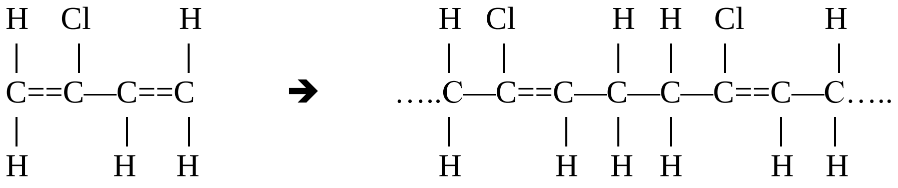
Many vinyl chloride monomers ➔ becomes polyvinyl chloride



$$\underset{\mathrm{H}}{\overset{\mathrm{H}}{\mathrm{C}}}=\underset{\mathrm{H}}{\overset{\mathrm{Cl}}{\mathrm{C}}} \rightarrow \ldots\underset{\mathrm{H}}{\overset{\mathrm{H}}{\mathrm{C}}}-\underset{\mathrm{H}}{\overset{\mathrm{Cl}}{\mathrm{C}}}-\underset{\mathrm{H}}{\overset{\mathrm{H}}{\mathrm{C}}}-\underset{\mathrm{H}}{\overset{\mathrm{Cl}}{\mathrm{C}}}-\underset{\mathrm{H}}{\overset{\mathrm{H}}{\mathrm{C}}}-\underset{\mathrm{H}}{\overset{\mathrm{Cl}}{\mathrm{C}}}-\underset{\mathrm{H}}{\overset{\mathrm{H}}{\mathrm{C}}}\ldots$$

Another polymer example would be neoprene, a substance used for oil resistant protective clothing. The monomer (2-chloro 1, 3-butadiene) combines into the neoprene polymer:

Many butadiene monomers ➔ becomes neoprene



$$\underset{\mathrm{H}}{\overset{\mathrm{H}}{\mathrm{C}}}=\overset{\mathrm{Cl}}{\mathrm{C}}-\underset{\mathrm{H}}{\mathrm{C}}=\underset{\mathrm{H}}{\overset{\mathrm{H}}{\mathrm{C}}} \rightarrow \ldots\underset{\mathrm{H}}{\overset{\mathrm{H}}{\mathrm{C}}}-\overset{\mathrm{Cl}}{\mathrm{C}}=\underset{\mathrm{H}}{\mathrm{C}}-\underset{\mathrm{H}}{\overset{\mathrm{H}}{\mathrm{C}}}-\underset{\mathrm{H}}{\overset{\mathrm{H}}{\mathrm{C}}}-\overset{\mathrm{Cl}}{\mathrm{C}}=\underset{\mathrm{H}}{\mathrm{C}}-\underset{\mathrm{H}}{\overset{\mathrm{H}}{\mathrm{C}}}\ldots$$

There are numerous other examples of halogenated polymers such as saran, which also do not need to be evaluated as a state-only persistent waste.

3.8.7 Examples of HOCs, Which MUST Be Evaluated for State-only Persistence

The following are provided as examples of compounds, which do **not** fall into the above categories and **must** be evaluated for state-only persistence designation. The following are intended solely to clarify the examples presented in above sections. They are not all encompassing but are intended to provide examples of types of compounds. If a generator is unsure whether his waste meets any of the exclusions in this document, they should contact their local Ecology office.

3.8.7.1 Chlorinated Paraffins

Chlorinated paraffins are mixtures of polychlorinated n-alkanes produced by the reaction of chlorine with specific normal paraffin fractions from petroleum distillation. Carbon-carbon lengths of commercial products are generally between C_{10} and C_{30}. The chlorine content is typically between 40 and 70 percent.

Chlorinated paraffins are used as plasticizers for polyvinyl chloride, as extreme-pressure additives in metal-machining fluids, as additives to paints, coatings, and sealants to improve their resistance to chemicals and to water, and as flame retardants for plastics, fabrics, paints, and coatings.

Chlorinated paraffins are believed to persist in the environment and therefore must be evaluated to determine if they meet Ecology’s state-only persistence requirement. For more information on chlorinated paraffins, see Appendix 3.

3.8.7.2 Polychlorinated Biphenyls (PCBs)

Polychlorinated Biphenyls (PCB) are regulated by other regulations such as the Toxic Substances Control Act (TSCA). Since PCBs meet the definition of HOCs, wastes containing PCBs must also be evaluated for state-only persistence. Even though the PCB concentration may fall below the regulated limit defined by such laws as TSCA, the total concentration of all HOCs must fall below the determined designation limit to not be considered state-only persistent waste. Therefore, some PCB wastes, which may not be regulated by laws such as TSCA, may still be identified as a state-only persistent waste depending on the total concentration of all HOC species present in the waste, including PCBs.

3.8.7.3 Polymer Additives

Additives are often combined with polymers to produce specific properties and are not included in the definition of polymer. Additives are not excluded and polymers containing these additives must be evaluated for persistence. Additives include but are not limited to:

- Fillers
- Pigments
- Plasticizers
- Flow improvers
- Stabilizers (usually added to prevent aging and degradation)
- Catalysts
- Fire retardants (polybrominated diphenyl ethers, tetrabromobisphenol A, and others)

If you have any questions concerning the additives in your particular polymer, please contact your local Ecology office.

3.9 Test Methods for Determining Polycyclic Aromatic Hydrocarbons

Polycyclic Aromatic Hydrocarbons (PAH) are clearly defined by the regulations through a specific list of chemicals. As with HOC, the total concentration must be determined by summing the concentration of each of the PAHs quantified by one of the methods listed below. No single method can detect all 20 PAHs listed in **Chapter 2, section 2.2.3.4.,** so generators should select the methods which either obtains the most PAHs possible or analyzes for those PAHs most likely to be found in the waste based on process knowledge.

If the total concentration of PAHs exceeds 10,000 ppm, the waste would then designate as an extremely hazardous waste (EHW). There is no DW concentration level for PAHs.

3.9.1 SW-846 Method 8100

Method 8100 is a test method for PAHs. Method 8100 is a packed column method, but capillary columns are allowed to be substituted. Although this test method will detect fifteen chemical compounds listed under the definition of PAHs, this method has a tendency to produce results biased high due to chromatographic interferences.

Since this method employs FID (flame ionization detection) which is basically a "universal" detector, (e.g., responds to most organic compounds regardless of chemical structure or molecular elemental composition), any organic compound which exists from the column at the same time as the compounds of interest would be interpreted as the compound of interest.

3.9.2 SW-846 Method 8310

Method 8310 is a method for PAHs using High Performance Liquid Chromatography (HPLC). This method, also, has a tendency to produce false high results, but is able to better distinguish between PAH pairs that might go unresolved in Method 8100. As the list of PAHs is so specific, Method 8310 is better at distinguishing 4-, 5-, and 6-ring compounds in the waste matrix**.** Ecology recommends Method 8310 over Method 8100.

3.9.3 SW-846 Method 8270D

Method 8270[14]D is the test method for Semi-volatile Organic Compounds by GC/MS. This method will detect fifteen compounds and is the most accurate of the `8000 series' methods available to detect PAHs. The GC/MS techniques have the ability to "look through" the interferences and determine how much of the peak corresponds to the target compound.

This method also has some limitations, particularly if there are interferences. Although Method 8270D is the most expensive analysis of the three methods listed, **Ecology strongly recommends the use of Method 8270D,** over Methods 8100 and 8310.

3.10 Optional Indicator Test Methods

These test methods are not required under the *Dangerous Waste Regulations* (WAC 173-303). The following tests are optional indicator test methods for designating dangerous waste.

3.10.1 SW-846 Method 1030 Ignitability of Solids

This method is suitable for the determination of the ignitability of solids and is appropriate for pastes, granular materials, solids that can be cut into strips, and powdery substances. This method may be used to meet certain regulatory applications; with respect to the characteristic of ignitability in CFR §

261.21, this method may be used, but is not required, to determine whether a solid waste "when ignited, burns so vigorously and persistently that it creates a hazard." If it is impractical to perform the test because of the physical form of the sample, generator knowledge should be used to determine the ignitability hazard posed by the material. This method is available on the web at: *www.epa.gov/epawaste/hazard/testmethods/sw846/pdfs/1030.pdf*

3.10.2 SW-846 Test Method 1050 to Determine Substances Likely to Spontaneously Combust

This method provides test procedures, which may be used to evaluate and categorize liquid and solid wastes that are likely to spontaneously combust. The method is based on the DOT regulations for the transport of spontaneously combustible materials as provided in 49 CFR Part 173, Appendix E.

These test procedures are intended to identify two types of wastes with spontaneous combustion properties:

- Wastes (including mixtures and solutions, liquid or solid) which, even in small quantities, ignite within five minutes of coming in contact with air. These wastes are the most likely to spontaneously combust and are considered to have pyrophoric properties.
- Other solid wastes which, in contact with air and without an energy supply, are susceptible to self-heating. These wastes will ignite only when in large amounts (kilograms) and after long periods of time (hours or days) and are considered having self-heating properties.

This method is not required by the Federal regulations to determine if a waste passes or fails the characteristic of ignitability according to the RCRA regulatory definition at 40 CFR 261.21. To clarify, the test results of this method cannot be used to directly classify a waste as a D001 hazardous waste, nor can the results be used by themselves to definitively classify a waste as non-hazardous.

No specific test for ignitable solids is required by the RCRA regulations, and only a waste meeting the narrative regulatory definition at 40 CFR 261.21(a) (2) is an ignitable hazardous waste because it is an ignitable solid.

In addition, the test in this method for a liquid may be helpful in determining whether a liquid waste has hazardous properties; however, a liquid waste is only a D001 hazardous waste if it is an oxidizer, as defined at 40 CFR 261.21(a) (4), or based on its flash point, as defined at 40 CFR 261.21(a) (1).

This test method was developed to specifically illustrate the ignitable properties of materials, including wastes and its results provide relevant and useful information that may be applied to knowledge of a waste in determining whether a waste meets the 40 CFR 261.21 criteria. This method is available on the web at: *www.epa.gov/epawaste/hazard/testmethods/sw846/pdfs/1050.pdf*.

3.10.3 SW-846 Method 1040 Test Methods for Oxidizing Solids

This test procedure is suitable for assessing the relative oxidizing hazard of solid substances, including solids, granular materials, and other materials that can be formed into a conical pile. This procedure is not appropriate for evaluating oxidizing liquids.

This method is not required by the Federal regulations to determine if a waste passes or fails the characteristic of ignitability according to the RCRA regulatory definition at 40 CFR 261.21. To clarify, the test results of this method cannot be used to directly classify a waste as a D001 hazardous waste, nor can the results be used by themselves to definitively classify a waste as non-hazardous.

No specific test for defining oxidizers is required by the RCRA regulations, and only a waste meeting the narrative regulatory definition at 40 CFR 261.21(a)(4) is an ignitable hazardous waste because of its oxidizer properties. However, this test method was developed to specifically illustrate the oxidizer properties of materials, including wastes, and its results provide relevant and useful information that may be applied to knowledge of a waste in determining whether a waste meets the 40 CFR 261.21(a)(4) criteria. This method is available on the web at: *www.epa.gov/epawaste/hazard/testmethods/sw846/pdfs/1040.pdf*.

Chapter 3 Endnotes

1a . The lists of methods were not intended to be used for waste designation or to meet regulatory requirements. Methods not in WAC 173-303-110 can be approved to support facility operations as part of a permit process or other non-regulatory requirements. Ecology **must** approve method(s) that are not specified in **WAC 173-303-110** before they can be used to designate waste.

1b. Washington State's accreditation program for laboratories is described in Chapter 173-303 WAC. Although using an accredited laboratory is not required to comply with WAC 173-303, Ecology recommends using accredited laboratories. Washington State's Laboratory accreditation program will, for a fee, provide certification for most methods. The certification is typically specific for a matrix like water, soil, etc. Before using an accredited laboratory, the generator should verify if the lab is accredited for both the analytical method and his sample matrix. A list of accredited labs is available on Ecology's Web site at *www.ecy.wa.gov/programs/eap/labs/lab-accreditation.html* or by contacting an Ecology regional office. For more information about Ecology's laboratory accreditation program, refer to publication #02-03-055, *Procedural Manual for the Environmental Laboratory Accreditation Program, November 2002.*

2. These methods can be found at *www.epa.gov/epaoswer/hazwaste/test/main.htm*. Ecology regional offices can also provide a copy. See inside the cover of this document for your nearest regional office.

3. Specifically, for Land Disposal Restrictions or LDR.

4. Federal Register: January 13, 1995, Vol. 60 page 3092.

5. Available on Ecology's Web site at *www.ecy.wa.gov/ecology* or can be obtained from any of Ecology's regional offices.

6. Ecology regional offices can also provide a copy of the test method.

7. Find SW-846 Method 9040C at *www.epa.gov/epaoswer/hazwaste/test/main.htm.* Ecology regional offices can also provide a copy. See inside the front cover of this document's for your nearest regional office. Aqueous content is based on testing

limitations. SW-846 defines a liquid as having greater than 20 percent aqueous content. A Solid has less than 20 percent aqueous content.

8. Find SW-846 Method 9045D at *www.epa.gov/epaoswer/hazwaste/test/main.htm*. Ecology regional offices can also provide a copy.
9. WAC 173-303-090 (6) (a) (iii).
10. ASTM Standard D4978-95(2007), "Standard Test Methods for Screening of Reactive Sulfides in Waste", ASTM International, West Conshohocken, PA 2007, DOI: 10.15201D4978-95R07. *www.astm.org/Standards/D4978.htm*.

11. Equivalent testing methods as described in WAC 173-303-110(5). "Any person may request the department to approve an equivalent testing method by submitting a petition, prepared in accordance with WAC 173-303-910(2), to the department".
12. Under the Model Toxics Control Act (MTCA), waste may be chemically tested to determine if MTCA cleanup levels have been met or to designate a waste.
13. WAC 173-303-100
14. USEPA, Superfund Analytical Services/Contract Laboratory Program (CLP), Multi-Media, Multi-Concentration Organics Analysis, SOM01.X, Exhibit D - Analytical Methods, "Analytical Method for the Analysis of Semi-volatile Organic Compounds," November, 2003.

Appendix 1

Glossary of Terms

Accuracy:	The degree of agreement of an analytical result with the true value. The accuracy of a result is affected by both systematic and random errors.
Analyte:	Denotes `that which is to be analyzed for' in chemical, but not physical or biological, determinations.
Analytical method:	Denotes a set of written instructions specifying an analytical procedure to be followed. The procedure provides an estimate of the concentration of an analyte.
Chemical Abstract Services (CAS) Number:	A unique identifying number given to chemical compounds and specialized mixtures of compounds. Regulated chemicals should be identified by their names and possible synonyms, which are many and varied, the unique CAS number for individual chemicals, and the CAS number of any regulated chemical contained in a specialized mixture.
Completeness:	A measure of the amount of useable data obtained from a project compared to the amount expected.
Constituent:	A chemically distinct component of a dangerous waste stream or mixture as per WAC 173-303-040.
Dangerous waste constituent:	Those constituents listed in WAC 173-303-9905 and any other constituents that have caused a waste to be a dangerous waste under Chapter 173-303 WAC.
Dangerous wastes:	Solid wastes identified as dangerous, or extremely hazardous or mixed waste. For the purposes of these regulations, the words "dangerous waste" will refer to all regulated wastes. The abbreviation "DW" will refer only to waste, which is not extremely hazardous waste (EHW).
Designation:	The process that determines whether a solid waste is a dangerous waste and, through the generator's assignment of applicable federal and/or state waste codes, identifies the specific lists, characteristics or criteria that caused the solid waste to designate. Dangerous wastes are assigned federal and state waste codes.
Disposal:	The discharging, discarding, or abandoning of dangerous wastes or the treatment, decontamination, or recycling of such wastes once they have been discarded or abandoned. This includes the discharge of any

	dangerous wastes into or on any land, air, or water, as per WAC 173-303-040.
Equivalent test method:	A laboratory or field testing method used to determine a waste's characteristics or contents that has been approved by Ecology in lieu of a method required by the regulations. An equivalent test method can only be approved by submitting a petition and receiving approval from Ecology.
Extremely hazardous waste:	Those dangerous and mixed wastes identified as extremely hazardous. The abbreviation "EHW" will be used to refer to only those dangerous and mixed wastes, which are extremely hazardous.
Generator:	Any person who produces dangerous waste or who first causes a dangerous waste to become subject to regulation.
Half-life:	The length of time it takes for the concentration of a substance to be reduced by one-half relative to its initial level, assuming first-order decay kinetics.
Halogenated organic compound:	Any organic compound which includes one or more atoms of fluorine, chlorine, bromine, or iodine bonded directly to a carbon atom.
Hazardous wastes:	Those solid wastes regulated as hazardous and/or mixed waste by the United States EPA.
Ignitable waste:	A dangerous waste which flashes below 140° F.
Leachate:	Any liquid that has percolated through or drained from dangerous waste. This includes any components suspended in the liquid.
NIOSH registry:	The registry of toxic effects of chemical substances published by the National Institute for occupational Safety and Health.
Organic/carbonaceous waste:	A dangerous waste that contains greater than ten percent organic or carbon based constituents. These constituents contain carbon-hydrogen, carbon-halogen, or carbon-carbon bonds.
Persistence:	Compounds that retains more than half of their initial activity after 365 days in either a dark anaerobic or dark aerobic environment at ambient conditions. These compounds are either a halogenated organic compound (HOC) or a polycyclic aromatic hydrocarbon (PAH).
Person:	Any individual, trust, firm, joint stock company, federal agency, corporation (including a government corporation), partnership, association, state, municipality, commission, political subdivision of a state, or any interstate body whatsoever.

Pesticide:	There are multiple meanings: 1. Any substance or mixture intended to prevent, destroy, control, repel, or mitigate any organism normally considered to by a pest. This includes insects, rodents, nematodes, mollusks, fungi, weeds, and any other plant or animal life, or virus (except viruses on or in living man or other animal) The department of agriculture may declare an organism to be a pest. 2. Any substance or mixture intended to be used as a plant regulator, defoliant, or desiccant. 3. Any substance or mixture intended to be used as spray adjuvant. 4. Any other substance named by the department of Agriculture. Ecology considers herbicides, fungicides, insecticides, and rodenticides to be pesticides.
Polymer:	A long, repeating chain formed from organic molecules via the linkage of many smaller molecules called monomers. A key feature that distinguishes polymers from other large molecules is the repetition of smaller units (monomers) in their chain. The process of linking the smaller units (monomers) together is called polymerization. For the purpose of this document, a polymer is defined as: 1. Long chains of repeating monomers with at least one halogen compound in the monomer attached to a carbon atom. 2. 100 or more repeating units (monomers) combined together into a single chain. 3. A compound having a number average molecular weight of at least 5,000. Although polymers may be persistent, they often do not degrade in the environment and, therefore, have minimal biological impact.
Polymer additives:	Compounds combined with polymers to produce specific properties. These additives are not included in the definition of polymer and must be evaluated to determine if they cause waste to designate as a state-only persistent waste. Additives include but are not limited to 1) fillers, 2) pigments, 3) plasticizers, 4) flow improvers, 5) stabilizers (usually added to prevent aging and degredation), 6) catalysts, and fire retardants.
Polycyclic aromatic hydrocarbons:	Compounds composed of two or more fused benzene rings. The PAHs of concern are: Acenaphthene, acenaphthylene, fluorene, anthracene, fluoranthene, phenanthrene, benzo(a)anthracene, benzo(b)fluoranthene, benzo(k)fluoranthene, pyrene, chrysene, benzo(a)pyrene, dibenz(a,h)anthracene, indeno(1,2,3-c,d)pyrene, benzo(g,h,i)perylene, dibenzo[(a,e), (a,h), (a,i), and (a, l)]pyrenes, and dibenzo(a,j)acridine.
Process knowledge:	Knowledge the generator applies to a solid waste to determine if it is a dangerous waste in light of the materials or the process used. Such knowledge can be used when the generator demonstrates the

	information to be sufficient for determining whether a solid waste is designated properly, as per WAC 173-303-070(3)(c)(ii).
Reactive waste:	A dangerous waste that exhibits the characteristic of reactivity described in WAC 173-303-090(7).
Sludge:	Any solid, semisolid, or liquid waste generated from a municipal, commercial, or industrial wastewater treatment plant, waste supply treatment plant, or air pollution control facility, as per 173-303-040. This term does not include the treated effluent from a wastewater treatment plant.
Solid acid waste:	A dangerous waste that exhibits the characteristic of low pH under the corrosivity tests of WAC 173-303-090(6)(a)(iii).
Toxic:	Having the properties to cause or to significantly contribute to death, injury, or illness of man or wildlife such as carcinogenicity, mutagenicity, or teratogenicity as per WAC 173-303-040.
Waste stream:	Waste streams have an individual point of generation. Individual waste streams include: 1. Wastes that are physically or chemically different from each other; 2. Wastes that are generated from different types of processes; and 3. Wastes that are the same type, but are generated at different points along the same process or at different process locations.

Appendix 2

Department of Transportation (DOT) Regulations - 49 CFR

found at: *www.access.gpo.gov/nara/cfr/waisidx_06/49cfr173_06.html*

A. Ignitable Liquids

1. 49 CFR § 173.120 Class 3—Definitions found at: *http://a257.g.akamaitech.net/7/257/2422/13nov20061500/edocket.access.gpo.gov/cfr_2006/octqtr/pdf/49cfr173.120.pdf*

B. Ignitable Compressed Gases

1. 49 CFR § 173.115 Class 2, Divisions 2.1, 2.2, and 2.3 Definitions found at: *http://a257.g.akamaitech.net/7/257/2422/13nov20061500/edocket.access.gpo.gov/cfr2006/octqtr/pdf/49cfr173.115.pdf*

C. Oxidizers

1. 49 CFR § 173.127 Class 5, Division 5.1--Definition and assignment of packing groups found at: *http://a257.g.akamaitech.net/7/257/2422/13nov20061500/edocket.access.gpo.gov/cfr_2006/octqtr/pdf/49cfr173.127.pdf*

2. 49 CFR § 173.128 Class 5, Division 5.2--Definitions and types found at: *http://a257.g.akamaitech.net/7/257/2422/13nov20061500/edocket.access.gpo.gov/cfr_2006/octqtr/pdf/49cfr173.128.pdf*

D. Explosives

1. 49 CFR § 173.50 Class 1 definitions found at: *http://a257.g.akamaitech.net/7/257/2422/13nov20061500/edocket.access.gpo.gov/cfr2006/octqtr/pdf/49cfr173.50.pdf*

2. 49 CFR § 173.53 Provisions for using old classifications of explosives found at: *http://a257.g.akamaitech.net/7/257/2422/13nov20061500/edocket.access.gpo.gov/cfr2006/octqtr/pdf/49cfr173.53.pdf*

3. 49 CFR § 173.54 Forbidden explosives found at: *http://a257.g.akamaitech.net/7/257/2422/13nov20061500/edocket.access.gpo.gov/cfr2006/octqtr/pdf/49cfr173.54.pdf*

4. 49 CFR § 173.56 New explosives--definition and procedures for classification and approval found at: *http://a257.g.akamaitech.net/7/257/2422/13nov20061500/edocket.access.gpo.gov/cfr2006/octqtr/pdf/49cfr173.56.pdf*

5. 49 CFR § 173.57 Acceptance criteria for new explosives found at: *http://a257.g.akamaitech.net/7/257/2422/13nov20061500/edocket.access.gpo.gov/cfr2006/octqtr/pdf/49cfr173.57.pdf*

Appendix 3

Chlorinated Paraffins

- Chlorinated paraffins are mixtures of polychlorinated n-alkanes produced by the reaction of chlorine with specific normal paraffin fractions from petroleum distillation.

- Carbon-carbon lengths of commercial products are generally between C_{10} and C_{30}.

- *www.eurochlor.org/chlorparaffins/generalinfo/info.htm*

    - Short chain
        - Based on C_{10}-C_{13} paraffin

    - Medium chain
        - Based on C_{14}-C_{17} paraffin

    - Long chain
        - Based on C_{18}-C_{20} paraffin

    - Wax grades
        - Average carbon chain length approximately C_{25}

- The chlorine content is typically between 40 and 70 percent.

- Chlorinated paraffins are used as plasticizers for polyvinyl chloride, as extreme-pressure additives in metal-machining fluids, as additives to paints, coatings, and sealants to improve their resistance to chemicals and to water, and as flame retardants for plastics, fabrics, paints, and coatings.

- Chlorinated paraffins have been detected in water and sediments, in tissues or marine animals, in human foods, and in human tissues *post mortem*.

- Synonyms

    A 70
    A 70 (wax)
    Adekacizer E
    Alkanes, chlorinated
    Arubren
    Cereclor
    Chlorcosane
    Chlorex
    Chorinated alkanes
    Chlorinated hydrocarbon waxes
    Chlorinated paraffin waxes
    Derminolfett
    Derminolol
    EDC-tar
    Electrofine
    Enpara
    Hordaflam
    Hordaflex
    Hordalub
    Hulz
    KhP
    Meflex

Chlorinated waxes
Chloroalkanes
Chlorocarbons
Chlorofin
Chloroflo
Chloroparaffin waxes
Chlorowax
Chlorparaffin
Cloparin
Cloparol
Clorafin CW
Monocizer
Paraffin waxes chlorinated
Paraffin, chlorinated
Paraffins, chloro
Poliks
Polychlorinated alkanes
Polychloro alkanes
Tenekil
Toyoparax
Unichlor

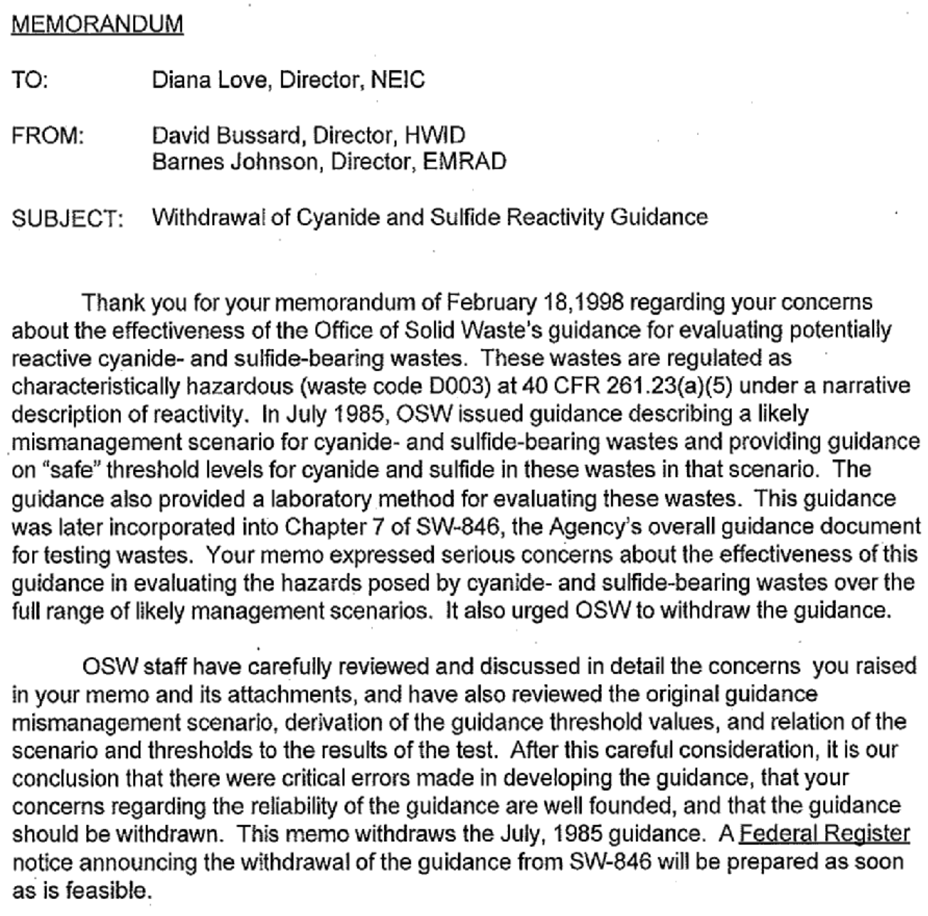
- Persistence/Fate: Chlorinated paraffins may be released into the environment from improperly disposed metal-working fluids or polymers containing chlorinated paraffins. Loss of chlorinated paraffins by leaching from paints and coatings may also contribute to environmental contamination. Short chain chlorinated paraffins with less than 50 percent chlorine content seem to be degraded under aerobic conditions. The medium and long chain products are degraded more slowly. Chlorinated paraffins are bioaccumulated and both uptake and elimination are faster for the substances with low chlorine content. *www.oztoxics.org/cmwg/chemicals/rbapts_chem/Paraffins.html*

- *http://archive.greenpeace.org/toxics/downtozero/POPS/ospar-list.html*

- *www.lgc.co.uk/docgallery/261.pdf*
    - analysis method

- *www.unece.org/env/documents/2003/eb/wg5/eb.air.wg.5.2003.3.e.pdf*
    - Page 9 contains specific persistence information.

Appendix 4



MEMORANDUM

TO: Diana Love, Director, NEIC

FROM: David Bussard, Director, HWID
Barnes Johnson, Director, EMRAD

SUBJECT: Withdrawal of Cyanide and Sulfide Reactivity Guidance

Thank you for your memorandum of February 18,1998 regarding your concerns about the effectiveness of the Office of Solid Waste's guidance for evaluating potentially reactive cyanide- and sulfide-bearing wastes. These wastes are regulated as characteristically hazardous (waste code D003) at 40 CFR 261.23(a)(5) under a narrative description of reactivity. In July 1985, OSW issued guidance describing a likely mismanagement scenario for cyanide- and sulfide-bearing wastes and providing guidance on "safe" threshold levels for cyanide and sulfide in these wastes in that scenario. The guidance also provided a laboratory method for evaluating these wastes. This guidance was later incorporated into Chapter 7 of SW-846, the Agency's overall guidance document for testing wastes. Your memo expressed serious concerns about the effectiveness of this guidance in evaluating the hazards posed by cyanide- and sulfide-bearing wastes over the full range of likely management scenarios. It also urged OSW to withdraw the guidance.

OSW staff have carefully reviewed and discussed in detail the concerns you raised in your memo and its attachments, and have also reviewed the original guidance mismanagement scenario, derivation of the guidance threshold values, and relation of the scenario and thresholds to the results of the test. After this careful consideration, it is our conclusion that there were critical errors made in developing the guidance, that your concerns regarding the reliability of the guidance are well founded, and that the guidance should be withdrawn. This memo withdraws the July, 1985 guidance. A Federal Register notice announcing the withdrawal of the guidance from SW-846 will be prepared as soon as is feasible.

Your memo raised several concerns about the guidance. These concerns and our replies are:

1. NEIC Concern: The current test does not evaluate waste over the full range of pH values specified in the regulation (pH 2 to 12.5). While the test begins with acid at pH 2, immediately after mixing with the waste, the pH of the mixture may change. It may be somewhere within the range of 2 to 12.5 if the waste does not bear much acidity or alkalinity (due to neutralization or stabilization), but it may not be within this range if the waste does bear substantial acidity or alkalinity. Nevertheless, the test evaluates a single pH condition and not the range of pH conditions (2 to 12.5) specified in the regulations.

   Reply: You are correct, the test will not always be run at the low end of the pH range specified in the regulation (and does not test at the high end of the range). However, the implications and importance of this are not clear, as solubility of the cyanide salts present also affects the rate of conversion to HCN. The addition of a fixed amount of acid with a pH of 2.0 to a waste that may have a substantially higher pH means that when these are mixed, the resulting pH will be higher than pH 2.0. The pH range specified in the regulation was chosen because outside of the pH range 2 to 12.5, the waste acid or base to which the evaluated material is added would be considered a corrosive hazardous waste, and consideration of waste compatibility would be required by 40 CFR 264.17 before the wastes are mixed. This would prevent many dangerous situations from occurring. However, an overwhelming volume of waste acid at pH 2 could be legally added to other wastes, with potentially dangerous effects if the other wastes bear releasable cyanides. In addition, some cyanide salts are much more soluble (and, therefore, more available to react) under high pH conditions; evaluation of hazard under these conditions, as well as at low pHs, should be explored.

2. NEIC Concern: The test and threshold limits presented in the 1985 memo fail to account for Henry's Law, which describes the air-aqueous partitioning of the toxic gases. The result is that the amount of nitrogen used in the test to recover the evolving hydrogen cyanide gas recovers only a small amount of the hydrogen cyanide gas generated. A similar problem, although not as severe, exists for the evolution of hydrogen sulfide gas. Both theoretical calculations and practical tests in our laboratory and other laboratories, demonstrate recoveries in the range of 2% to 3% of the cyanide present. Somewhat higher recoveries are obtained for sulfide, but still not a quantitative recovery.

   Reply: In developing the guidance test, the Agency was not seeking a method that would achieve complete recoveries of hydrogen cyanide and hydrogen sulfide, but rather was attempting to evaluate the risks from wastes in a particular mismanagement scenario. Because hydrogen cyanide is extremely soluble in water, high recovery rates will not be achievable. Henry's Law may be important for assessing hydrogen sulfide, but does not appear to be critical to our judgements about highly soluble gases or to gases that interact with water. This may explain the differences in recovery between hydrogen cyanide and hydrogen sulfide as measured in NEIC tests. We will work with your staff to better understand the role of Henry's Law in the evolution of dissolved HCN gas as we develop revised guidance.

3. NEIC Concern: The test method and the mismanagement scenario are different with respect to air volume, aqueous solution volume, and the amount of waste. According to Henry's Law, this means that toxic gas partitioning between the air and aqueous volumes will be different. The threshold limits fail to account for these differences, and thus are not founded in good science.

   Reply: We have reviewed the original mismanagement scenario and laboratory test conditions, and agree that the conditions (air volume, aqueous solution volume, and waste mass) are different and not correctly scaled between the mismanagement scenario and test (see Attachment 1). There were also several errors made in setting up the calculations in the mismanagement scenario (see Attachments 2 and 3). The fact that these important parameters are mismatched in the laboratory test and the open pit mismanagement scenario means that the test (under these conditions), and the threshold values, do not evaluate the mismanagement scenario conditions. Also, the "dumpster" and "tank" mismanagement scenarios, and your theoretical calculations, described in Attachment II, indicate that the open pit scenario used in the 1985 guidance may not be a true plausible worst case mismanagement/exposure scenario. The Agency clearly needs to consider these alternative mismanagement scenarios as revised guidance is developed.

Until revised guidance is developed, we reiterate the RCRA regulatory language. That is, 40 CFR 261.23(a)(5) specifies that human health and the environment must not be endangered by evolved toxic gases when these wastes are exposed to pH conditions between 2 and 12.5. Any waste causing a hazard, when in the pH range of 2-12.5, would certainly be considered a characteristic hazardous waste.

We understand that withdrawal of the guidance today means that waste generators who have relied on this guidance in the past will, in the near term, have somewhat greater uncertainty about determining the regulatory status of their cyanide- and sulfide-bearing wastes. However, the Agency believes that generators of sulfide- and cyanide-bearing wastes can recognize the acute toxicity of sulfides and cyanides without relying on the test in the guidance. Where wastes with high concentrations of soluble sulfides and cyanides are being managed, generators have relied on their knowledge of the waste to classify them as D003. The Agency expects that generators should continue to classify their high concentration sulfide- and cyanide-bearing wastes as hazardous based on the narrative standard.

Regarding LDR treatment requirements, there are numerical treatment standards for cyanide waste in 40 CFR 268.40 (compliance with these standards is based on different tests than the tests under consideration in this memo; nothing in this memo changes those standards in any way). However, the reactive sulfide treatment standards require that the waste be "deactivated", without specifying numerical treatment standards. Withdrawal of the guidance may leave some generators uncertain about the type and degree of treatment needed to meet the standard for sulfide-bearing wastes. The treatment methods described in 40 CFR 268 Appendix VI, when operated appropriately, can effectively treat sulfide reactive wastes.

Going forward, OSW staff will contact your staff to begin the effort to delete the cyanide and sulfide guidance values and test methodology from Chapter 7 of SW-846. We will also coordinate with your staff to create a working group to explore the development of more specific alternative guidance that relies on: (1) our improved modeling tools for evaluating hazards posed by cyanide- and sulfide-bearing wastes; and (2) better chemical analysis tools for measuring HCN and H_2S release.

Attachments (3)

ATTACHMENT 1: COMPARISON OF CYANIDE/SULFIDE TEST CONDITIONS AND MISMANAGEMENT SCENARIO CONDITIONS

Issue	Treatment in test	Treatment in mismanagement scenario
Air Volume	60 ml/min X 30 min= 1.8L = 0.0018m^3 (Test uses nitrogen flow through enclosed flask)	15m X 1.5m X 4 m= 90m^3 (A fixed block of unmixed air moves across the pit)
Liquid volume	250 ml less waste vol	Not specified in scenario. Approx 15m X 15m X 2.5m=600m^3
Time	30 min X 60 sec/min= 1800 sec	Assumes 10 seconds for a fixed air volume to move across the pit and become contaminated
Mass of waste available to react	10 g waste sample	10% per second of 6130 kg (for 10 seconds)
Total HCN released to cause 10 mg/m^3 HCN	10 mg/m^3 X 0.0018 m^3=0.018 mg HCN	10 mg/m^3 X 90 m^3=900 mg
Ratio air vol/mass waste	0.0018 m^3/0.010 kg=0.18 m^3/kg waste	90 m^3/6130 kg=0.015 m^3/kg waste
Evolution rate of HCN per kg waste present	(0.018mg/1800 sec)/ 0.01 kg waste = 0.001 mg-sec^{-1}/kg waste	(900 mg/10 sec)/6130 kg= 0.015 mg-sec^{-1}/kg waste
Theoretical HCN evolution rate	0.018 mg/1800 sec=1 X 10^{-5}mg/sec	900 mg/10 sec= 90 mg/sec
Total HCN needed to be evolved per kg waste present to cause 10 mg/m^3 HCN	0.018 mg HCN/0.010 kg sample= 1.8 mg HCN/kg waste	900 mg HCN/6130 kg = 0.15 mg HCN/kg waste

ATTACHMENT 2: ANALYSIS OF CALCULATIONS IN JULY 1985 RELEASABLE SULFIDE/CYANIDE GUIDANCE

Calculation presented in mismanagement scenario:

$$R = \text{Guidance threshold level} = \frac{\text{Amount of toxic gas that has to be released/length of test}}{\text{Mass of waste available to release } H_2S \text{ (or HCN)}} \qquad (1)$$

Adding values to the calculation:

$$R = \frac{(V)\,(C)\,(1800/10)}{(M/10)} \qquad (2)$$

Where: V= the contaminated air volume= 90 m^3
C= air threshold level=10 mg/m^3
1800= Seconds in laboratory test
10 (numerator)= Seconds in mismanagement scenario-- i.e., it takes 10 seconds for the slice of air to move across the pit
M=mass of waste =6130 kg
10=(denominator) percentage of pit area available to contaminate air, per second= 10%-sec^{-1}

Note: Not all values were labeled with units in the guidance memo; assumed units based on information provided in the guidance are: the 1800 seconds, 10 seconds (numerator) and 10%-sec^{-1} (denominator).

$$R = \frac{(90m^3)\,(10\ mg/m^3)\,(1800sec/10sec)}{(6130kg/10\%\text{-}sec^{-1})} \qquad (3)$$

R= 264 mg-sec HCN/kg waste (4)

In performing the above calculation, the units fail to cancel to the units of the threshold value of 250 mg/kg waste. There is an extra "seconds" left over which makes the units of the calculation mg-sec/kg waste, a nonsense result.

> Also, in moving from the initial form of the calculation (1) to addition of values (2), the equation appears to change. In (1) the total mass of HCN needed to contaminate the air is divided by the length of the test. In (2), the total amount of HCN needed to contaminate the air volume is multiplied by the ratio of the time in the laboratory test to the time it takes the slice of air to move across the pit and become contaminated.

However, the more fundamental error is in introducing time into the equation at all; there are two time errors. The first is in introducing the test time frame (1800 sec) into the mismanagement scenario calculation. This results in an 1800-fold error in the resulting threshold value, and a trailing "seconds" unit. The second time error is in requiring 10% per second of the waste be available to contaminate the $90m^3$ of air as it moves across the pit in 10 seconds. The values and units here cancel out, but there is still the trailing "seconds" from the 1800 seconds on test that results in nonsense units on the answer.

Because the air volume to be contaminated is fixed and unmixed, the only important calculation is the total amount of HCN evolution required to contaminate the $90m^3$ slice of air above the pit. If we want a standard in relation to the amount of waste present, then:

$$R=\frac{(90m^3)\ (10\ mg/m^3)}{6130\ kg\ waste}$$

$$R=0.147\ mg\ HCN/kg\ waste$$

If this result is multiplied by the erroneously included 1800 seconds, the result is 264 mg-sec HCN/kg waste, the incorrect guidance value in the 1985 memo.

The attached table (Attachment 1) shows that this calculated result is unrelated to the laboratory test it was associated with. If we want to relate this result to laboratory test results, additional calculations that correctly scale the static conditions of the mismanagement scenario to static test conditions would be needed. Time (or gas evolution rate) could be added to this guidance value and the laboratory test with additional development work. Developers of the guidance and test apparently believed the rate of gas evolution was important (since they included it in the calculations), they simply included it incorrectly.

However, another significant concern about presenting the guidance in this form (i.e., mg HCN/kg waste) is that the guidance value is totally dependent on the waste volume (and air volume) used. A tenfold change in the waste volume or static air volume results in a tenfold change in the guidance threshold, a clearly unsatisfactory result. Revised guidance will need to incorporate the need to consider mismanagement scenarios different from the one presented in the guidance.

Appendix 5

Appendix IX of 40 CFR 264

Groundwater Monitoring List currently applicable in Washington State[1]

Common Name[2]	CAS RN[3]	Chemical abstracts service index name[4]	Suggested methods[5]	PQL (mg/L)[6]
Acenaphthene	83-32-9	Acenaphthylene, 1,2-dihydro-	8100, 8310 8270	200 10
Acenaphthylene	208-96-8	Acenaphthylene	8100, 8310 8270	200 10
Acetone	67-64-1	2-Propanone	8260	100
Acetophenone	98-86-2	Ethanone, 1-phenyl-	8270	10
Acetonitrile; Methyl cyanide	75-05-8	Acetonitrile	8015	100
2-Acetylaminofluorene; 2-AAF	53-96-3	Acetaminde, N-9H-fluoren-2-yl	8270	10
Acrolein	107-02-8	2-Propenal	8260	5 5
Acrylonitrile	107-13-1	2-Propenenitrile	8031 8260	5 5
Aldrin	309-00-2	1,4:5,8-Dimethanonaphthalene, 1,2,3,4,10,10-hexachloro-1,4,4a,5,8,8a-hexahydro-(1α, 4α, 4aβ, 5α, 8α, 8aβ-	8081 8270	0.05 10
Allyl chloride	107-05-1	1-Propene, 3-chloro-	8260	5 100
4-Aminobiphenyl	92-67-1	[1,1’-Biphenyl]- 4-amine	8270	10
Aniline	62-53-3	Benzenamine	8270	10
Anthracene	120-12-7	Anthracene	8100 8270	200 10
Antimony	(Total)	Antimony	6010 7010, 7062 7000	300 2,000 30

Common Name[2]	CAS RN[3]	Chemical abstracts service index name[4]	Suggested methods[5]	PQL (mg/L)[6]
Aramite	140-57-8	Sulfurous acid, 2-chloroethyl 2-[4-(1,1-dimethylethyl) phenoxy]-1-methylethyl ester	8270	10
Arsenic	(Total)	Arsenic	6010 7062, 7063 7061	500 10 20
Barium	(Total)	Barium	6010 7000	20 1,000
Benzene	71-43-2	Benzene	8021 8260	2 5
Benzo[a]anthracene; Benzanthracene	56-55-3	Benz[a]anthracene	8100 8270, 8310	200 10
Benzo[b]fluoranthene	205-99-2	Benz[e]acephenanthrylene	8100, 8310 8270	200 10
Benzo[k]fluoranthene	207-08-9	Benzo[k]fluoranthene	8100 8270, 8310	200 10
Benzo[ghi]perylene	191-24-2	Benzo[ghi]perylene	8100, 8310 8270	200 10
Benzo[a]pyrene	50-32-8	Benzo[a]pyrene	8100, 8310 8270	200 10
Benzyl alcohol	100-51-6	Benzenemethanol	8270	20
Beryllium	(Total) 7440-41-7	Beryllium	6010 7000	3 2
alpha-BHC	319-84-6	Cyclohexane, 1,2,3,4,5,6-hexachloro-, (1α, 2α, 3β, 4α, 5β, 6β)-	8081	0.05 10
beta-BHC	319-85-7	Cyclohexane, 1,2,3,4,5,6-hexachloro-, (1α, 2β, 3α, 4β, 5α, 6β)-	8081	0.05 40
delta-BHC	319-86-8	Cyclohexane, 1,2,3,4,5,6-hexachloro-, (1α, 2α, 3α, 4β, 5α, 6β)-	8081	0.1 30
gamma-BHC; Lindane	58-89-9	Cyclohexane, 1,2,3,4,5,6-hexachloro-, (1α, 2α, 3β, 4α, 5α, 6β)-	8081	0.05 10
Bis(2-chloroethoxy)methane	111-91-1	Ethane, 1,1’-[methylenebis(oxy)]bis [2-chloro-	8270	10
Bis(2-chloroethyl)ether	111-44-4	Ethane, 1,1’-oxybis[2-chloro-	8270	10

Common Name[2]	CAS RN[3]	Chemical abstracts service index name[4]	Suggested methods[5]	PQL (mg/L)[6]
Bis(2-chloro-1-methylethyl) ether; 2,2’-Dichlorodiisopropyl ether	108-60-1	Propane, 2,2’-oxybis[1-chloro	8021 8270	100 10
Bis(2-ethylhexyl) phthalate	117-81-7	1,2-Benzenedicarboxylic acid, Bis (2-ethylhexyl) ester	8061 8270	20 10
Bromodichloromethane	75-27-4	Methane, bromodichloro-	8021 8260	1
Bromoform; Tribromomethane	75-25-2	Methane, tribromo-	8021 8260	2
4-Bromophenyl phenyl ether	101-55-3	Benzene, 1-bromo-4-phenoxy-	8270	10
Butyl benzyl phthalate; Benzyl butyl phthalate	85-68-7	1,2-Benzenedicarboxylic acid, butyl phenylmethyl ester	8061 8270	5 10
Cadmium	(Total)	Cadmium	6010 7000 7010	40 50 1
Carbon disulfide	75-15-0	Carbon disulfide	8260	5
Carbon tetrachloride	56-23-5	Methane, tetrachloro-	8021 8260	1 5
Chlordane	57-74-9	4,7-Methano-1H-indene,1,2,4,5,6,7,8,8-octachloro-2,3,3a,4,7,7a- hexahydro-	8081	0.1 10
p-Chloroaniline	106-47-8	Benzenamine, 4-chloro-	8270	20
Chlorobenzene	108-90-7	Benzene, chloro-	8021 8260	2 2 5
Chlorobenzilate	510-15-6	Benzene acetic acid, 4-chloro-α-(4-chlorophenyl)- α-hydroxy-, ethyl ester,	8270 8081	10
p-Chloro-m-cresol	59-50-7	Phenol, 4-chloro-3-methyl	8270	5 20
Chloroethane; Ethyl chloride	75-00-3	Ethane, chloro-	8021 8260	5 10

Common Name[2]	CAS RN[3]	Chemical abstracts service index name[4]	Suggested methods[5]	PQL (mg/L)[6]
Chloroform	67-66-3	Methane, trichloro	8021 8260	0.5 5
2-Chloronaphthalene	91-58-7	Naphthalene, 2-chloro-	8121 8270	10 10
2-Chlorophenol	95-57-8	Phenol, 2-chloro-	8041 8270	5 10
4-Chlorophenyl phenyl ether	7005-72-3	Benzene, 1-chlor-4-phenoxy-	8270	10
Chloroprene	126-99-8	1,3-Butadiene, 2-cloro-	8021 8260	50 5
Chromium	(Total) 7440-47-3	Chromium	6010, 6020 7000, 7010	70 500
Chrysene	218-01-9	Chrysene	8100, 8310 8270	200 10
Cobalt	(Total) 7440-48-4	Cobalt	6010 7000, 7010	70 500 10
Copper	(Total)	Copper	6010 7000, 7010	60 200
m-Cresol	108-39-4	Phenol, 3-methyl-	8270,8041	10
o-Cresol	95-48-7	Phenol, 2-methyl-	8270, 8041	10
p-Cresol	106-44-5	Phenol, 4-methyl-	8270, 8041	10
Cyanide	57-12-5	Cyanide	9010, 9012, 9014	40
2,4-D; 2,4-Dichlorophenoxyacetic acid	94-75-7	Acetic acid, (2,4-dichlorophenoxy)-	8151	10
4,4 ‘-DDD	72-54-8	Benzene 1,1’-(2,2-dichloroethylidene) bis [4-chloro-	8081 8270	0.1 10
4,4 ‘-DDE	72-55-9	Benzene 1,1’-(2,2-dichloroethenylidene) bis [4-chloro-	8081 8270	0.05 10
4,4 ‘-DDT	50-29-3	Benzene 1,1’ -(2,2,2-trichloroethylidene) bis [4-chloro-	8081 8270	0.1 10

Common Name[2]	CAS RN[3]	Chemical abstracts service index name[4]	Suggested methods[5]	PQL (mg/L)[6]
Diallate	2303-16-4	Carbamothioic acid, bis(1-methylethyl)-, S-(2,3-dichloro-2-propenyl) ester	8270 8081	10
Dibenz[a,h] anthracene	53-70-3	Dibenz[a,h] anthracene	8100, 8310 8270	200 10
Dibenzofuran	132-64-9	Dibenzofuran	8270	10
Dibromochloromethane; Chlorodibromomethane	124-48-1	Methane, dibromochloro-	8021 8260	1 5
1,2-Dibromo-3-chloropropane; DBCP	96-12-8	Propane, 1,2-dibromo-3-chloro-	8021 8260 8270	100 5 10
1,2-Dibromoethane; Ethylene dibromide	106-93-4	Ethane, 1,2-dibromo-	8021 8260	10 5
Di-n-butyl phthalate	84-74-2	1,2-Benzenedicarboxylic acid, dibutyl ester	8061 8270	5 10
o-Dichlorobenzene	95-50-1	Benzene, 1,2-dichloro	8021 8121 8270	2 5 10 10
m-Dichlorobenzene	541-73-1	Benzene, 1,3-dichloro	8021 8020 8120 8270	5 5 10 10
p-Dichlorobenzene	106-46-7	Benzene, 1,4-dichloro	8021 8121 8270	2 5 15 10
3,3 ‘-Dichlorobenzidine	91-94-1	[1,1‘-Biphenyl]-4,4‘-diamine, 3,3‘-dichloro-	8270	20
trans-1,4-Dichloro-2-butene	110-57-6	2-Butene, 1,4-dichloro-, (E)-	8260	5
Dichlorodifluoromethane	75-71-8	Methane, dichlorodifluoro-	8021 8260	10 5
1,1-Dichloroethane	75-34-3	Ethane, 1,1-dichloro-	8021 8260	1 5

Common Name[2]	CAS RN[3]	Chemical abstracts service index name[4]	Suggested methods[5]	PQL (mg/L)[6]
1,2-Dichloroethane; Ethylene dichloride	107-06-2	Ethane, 1,2-dichloro	8021 8260	0.5 5
1,1-Dichloroethylene; Vinylidene chloride	75-35-4	Ethene, 1,1-dichloro-	8021 8260	1 5
trans-1,2-Dichloroethylene	156-60-5	Ethene, 1,2-dichloro-, (E)-	8021 8260	1 5
2,4-Dichlorophenol	120-83-2	Phenol, 2,4-dichloro-	8041 8270	5 10
2,6-Dichlorophenol	87-65-0	Phenol, 2,6-dichloro-	8270, 8041	10
1,2-Dichloropropane	78-87-5	Propane, 1,2-dichloro-	8021 8260	0.5 5
cis-1,3-Dichloropropene	10061-01-5	1-Propene, 1,3-dichloro-, (Z)-	8021 8260	20 5
trans-1,3-Dichloropropene	10061-02-6	1-Propene, 1,3-dichloro-, (E)-	8021 8260	5 5
Dieldrin	60-57-1	2,7:3,6-Dimethanonaphth [2,3-b]oxirene, 3,4,5,6,9,9-hexachloro- 1a,2,2a,3,6,6a,7,7a-octahydro- ,(1aα,2β, 2aα,3β,6β,6aα,7β,7aα)-	8081 8270	0.05 10
Diethyl phthalate	84-66-2	1,2-Benzenedicarboxylic acid, diethyl ester	8061 8270	5 10
O,O-Diethyl O-2-pyrazinyl phosphorothioate; Thionazin	297-97-2	Phosphorothioic acid, O,O-diethyl O-pyrazinyl ester	8270	10
Dimethoate	60-51-5	Phosphorodithioic acid, O,O-dimethyl S-[2-(methylamino)-2-oxoethyl] ester	8270	10
p-(Dimethylamino)azobenzene	60-11-7	Benzenamine, N,N-dimethyl-4-(phenylazo)-	8270	10
7,12-Dimethylbenz[a]anthracene	57-97-6	Benz[a]anthracene, 7,12-dimethyl-	8270	10
3,3’-Dimethylbenzidine	119-93-7	[1,1’-Biphenyl]-4,4’-diamine, 3,3’-dimethyl-	8270	10
alpha, alpha-Dimethylphenethylamine	122-09-8	Benzeneethanamine,α,α-dimethyl-	8270	10

Common Name[2]	**CAS RN**[3]	**Chemical abstracts service index name**[4]	**Suggested methods**[5]	**PQL (mg/L)**[6]
2,4-Dimethylphenol	105-67-9	Phenol, 2,4-dimethyl-	8041 8270	5 10
Dimethyl phthalate	131-11-3	1,2-Benzenedicarboxylic acid, dimethyl ester	8061 8270	5 10
m-Dinitrobenzene	99-65-0	Benzene, 1,3-dinitro-	8270	10
4,6-Dinitro-o-cresol	534-52-1	Phenol, 2-methyl-4,6-dinitro-	8041 8270	150 10
2,4-Dinitrophenol	51-28-5	Phenol, 2,4-dinitro-	8041 8270	150 50
2,4-Dinitrotoluene	121-14-2	Benzene, 1-methyl-2,4-dinitro-	8091 8270	0.2 10
2,6-Dinitrotoluene	606-20-2	Benzene, 2-methyl-1,3-dinitro-	8091 8270	0.1 10
Dinoseb; DNBP; 2-sec-Butyl-4,6-dinitrophenol	88-85-7	Phenol, 2-(1-methylpropyl)-4,6-dinitro-	8151 8270	1 10
Di-n-octyl phthalate	117-84-0	1,2-Benzenedicarboxylic acid, dioctyl ester	8061 8270	30 10
1,4-Dioxane	123-91-1	1,4-Dioxane	8015	150
Diphenylamine	122-39-4	Benzenamine, N-phenyl-	8270	10
Disulfoton	298-04-4	Phosphorodithioic acid, O,O-diethyl S-[2-(ethylthio)ethyl]ester	8141 8270	2 10
Endosulfan I	959-98-8	6,9-Methano-2,4,3-benzodioxathiepin,6,7,8,9,10,10-hexachloro-1,5,5a,6,9,9a-hexahydro-, 3-oxide, (3α,5aβ,6α,9α,9aβ)-	8081 8270	0.1 10
Endosulfan II	33213-65-9	6,9-Methano-2,4,3-benzodioxathiepin, 6,7,8,9,10,10-hexachloro-1,5,5a,6,9,9a-hexahydro-,3-oxide, (3α,5aα,6β,9β,9aα)-	8081 8270	0.05
Endosulfan sulfate	1031-07-8	6,9-Methano-2,4,3-benzodioxathiepin, 6,7,8,9,10,10-hexachloro-1,5,5a,6,9,9a-hexahydro-, 3, 3-dioxide	8081 8270	0.5 10

Common Name[2]	CAS RN[3]	Chemical abstracts service index name[4]	Suggested methods[5]	PQL (mg/L)[6]
Endrin	72-20-8	2,7:3,6-Dimethanonaphth[2,3-b]oxirene, 3,4,5,6,9,9-hexachloro-1a,2,2a,3,6,6a,7,7a-octahydro-,(1aα, 2β,2aβ),3α,6α,6aβ,7β,7aα)-	8081 8270	0.1 10
Endrin aldehyde	7421-93-4	1,2,4-Methenocyclopenta[cd]pentalene-5-carboxaldehyde, 2,2a,3,3,4,7-hexachlorodecahydro-, (1α,2β,2aβ,4β,4aβ,5β,6aβ,6bβ,7R*)-	8081 8270	0.2 10
Ethylbenzene	100-41-4	Benzene, ethyl-	8021 8260	2 5
Ethyl methacrylate	97-63-2	2-Propenoic acid, 2-methyl-, ethyl ester	8015 8260 8270	10 5 10
Ethyl methanesulfonate	62-50-0	Methanesulfonic acid, ethyl ester	8270	10
Famphur	52-85-7	Phosphorothioic acid, O-[4-[(dimethylamino)sulfonyl] phenyl]-O, O-dimethyl ester	8270	10
Fluoranthene	206-44-0	Fluoranthene	8100, 8310 8270	200 10
Fluorene	86-73-7	9H-Fluorene	8100, 8310 8270	200 10
Heptachlor	76-44-8	4,7-Methano-1H-indene,1,4,5,6,7,8,8-heptachloro-3a,4,7,7a-tetrahydro-	8081 8270	0.05 10
Heptachlor epoxide	1024-57-3	2,5-Methano-2H-indeno[1,2-b]oxirene, 2,3,4,5,6,7,7-Heptachloro-1a,1b,5,5a,6,6a,-hexahydro-, (1aα,1bβ,2α,5α,5aβ,6β,6aα)	8081 8270	1 10
Hexachlorobenzene	118-74-1	Benzene, hexachloro-	81218270	10
Hexachlorobutadiene	87-68-3	1,3-Butadiene, 1,1,2,3,4,4-hexachloro-	81218270	10
Hexachlorocyclopentadiene	77-47-4	1,3-Cyclopentadiene, 1,2,3,4,5,5- hexachloro-	81218270	10
Hexachloroethane	67-72-1	Ethane, hexachloro-	81218270	10

Common Name[2]	CAS RN[3]	Chemical abstracts service index name[4]	Suggested methods[5]	PQL (mg/L)[6]
Hexachlorophene	70-30-4	Phenol, 2,2’- methylenebis[3,4,6-trichloro-	8270	10
Hexachloropropene	1888-71-7	1-Propene, 1,1,2,3,3,3- hexachloro-	8270	10
2-Hexanone	591-78-6	2-Hexanone	8260	50
Indeno(1,2,3-cd)pyrene	193-39-5	Indeno[1,2,3-cd]pyrene	8100 8270	200 10
Isobutyl alcohol	78-83-1	1-Propanol, 2-methyl-	8015	50
Isodrin	465-73-6	1,4,5,8- Dimethanonaphthalene,1,2,3,4,10,10-hexachloro-1,4,4a,5,8,8a hexahydro-(1α,4α,4aβ,5β,8β,8aβ)-	8270	10
Isophorone	78-59-1	2-Cyclohexen-1-one, 3,5,5- trimethyl-	8270	10
Isosafrole	120-58-1	1,3-Benzodioxole, 5-(1-propenyl)-	8270	10
Kepone	143-50-0	1,3,4-Metheno-2H-cyclobuta-[cd]pentalen-2-one, 1,1a,3,3a,4,5,5,5a,5b,6-decachlorooctahydro-	8270	10
Lead	(Total)	Lead	6010 7000 7010	40 N/A 10
Mercury	(Total)	Mercury	7470, 7471, 7473	2
Methacrylonitrile	126-98-7	2-Propenenitrile, 2-methyl-	8015	5
Methapyrilene	91-80-5	1,2,Ethanediamine, N,N-dimethyl-N’-2-pyridinyl-N’ (2-thienylmethyl)-	8270	10
Methoxychlor	72-43-5	Benzene, 1,1’-(2,2,2,trichloroethylidene)bis[4-methoxy-	8081 8270	2 10
Methyl bromide; Bromomethane	74-83-9	Methane, bromo-	8021 8260	20 10
Methyl chloride; Chloromethane	74-87-3	Methane, chloro-	8021 8260	1 10
3-Methylcholanthrene	56-49-5	Benz[j]aceanthrylene, 1,2-dihydro-3-methyl-	8270	10
Methylene bromide; Dibromomethane	74-95-3	Methane, dibromo-	8021 8260	15 5

Common Name[2]	CAS RN[3]	Chemical abstracts service index name[4]	Suggested methods[5]	PQL (mg/L)[6]
Methylene chloride; Dichloromethane	75-09-2	Methane, dichloro-	8021 8260	5 5
Methyl ethyl ketone; MEK	78-93-3	2-Butanone	8015 8260	10 100
Methyl iodide; Iodomethane	74-88-4	Methane, iodo-	 8260	40 5
Methyl methacrylate	80-62-6	2-Propenoic acid, 2-methyl-, methyl ester	8015 8260	2 5
Methyl methanesulfonate	66-27-3	Methanesulfonic acid, methyl ester	8270	10
2-Methylnaphthalene	91-57-6	Naphthalene, 2-methyl-	8270	10
Methyl parathion; Parathion methyl	298-00-0	Phosphorothioic acid, O,O-dimethyl O-(4-nitrophenyl) ester	81418270	0.5 10
4-Methyl-2-pentanone; Methyl isobutyl ketone	108-10-1	2-Pentanone, 4-methyl-	8015 8260	5 50
Naphthalene	91-20-3	Naphthalene	8100, 8300 8270, 8310	200 10
1,4-Naphthoquinone	130-15-4	1,4-Naphthalenedione	8270	10
1-Naphthylamine	134-32-7	1-Naphthalenamine	8270	10
2-Naphthylamine	91-59-8	2-Naphthalenamine	8270	10
Nickel	(Total)	Nickel	6010 7010	50 400
o-Nitroaniline	88-74-4	Benzenamine, 2-nitro-	8270	50
m-Nitroaniline	99-09-2	Benzenamine, 3-nitro-	8270	50
p-Nitroaniline	100-01-6	Benzenamine, 4-nitro-	8270	50
Nitrobenzene	98-95-3	Benzene, nitro-	8091 8270	40 10
o-Nitrophenol	88-75-5	Phenol, 2-nitro-	8041 8270	5 10
p-Nitrophenol	100-02-7	Phenol, 4-nitro-	8041 8270	10 50
4-Nitroquinoline 1-oxide	56-57-5	Quinoline, 4-nitro-, 1-oxide	8270	10

Common Name[2]	CAS RN[3]	Chemical abstracts service index name[4]	Suggested methods[5]	PQL (mg/L)[6]
N-Nitrosodi-n-butylamine	924-16-3	1-Butanamine, N-butyl-N-nitroso-	8270	10
N-Nitrosodiethylamine	55-18-5	Ethanamine, N-ethyl-N-nitroso-	8270	10
N-Nitrosodimethylamine	62-75-9	Methanamine, N-methyl-N-nitroso-	8270	10
N-Nitrosodiphenylamine	86-30-6	Benzenamine, N-nitroso-N-phenyl-	8270	10
N-Nitrosodipropylamine; Di-n-propylnitrosamine	621-64-7	1-Propanamine, N-nitroso-N-propyl-	8270	10
N-Nitrosomethylethylamine	10595-95-6	Ethanamine, N-methyl-N-nitroso-	8270	10
N-Nitrosomorpholine	59-89-2	Morpholine, 4-nitroso-	8270	10
N-Nitrosopiperidine	100-75-4	Piperidine, 1-nitroso-	8270	10
N-Nitrosopyrrolidine	930-55-2	Pyrrolidine, 1-nitroso-	8270	10
5-Nitro-o-toluidine	99-55-8	Benzenamine, 2-methyl-5-nitro-	8270	10
Parathion	56-38-2	Phosphorothioic acid,O,O-diethyl-O-(4-nitrophenyl) ester	8270	10
Polychlorinated biphenyls; PCBs	See Note 7	1,1'-Biphenyl, chloro derivatives	8082 8270	50
Polychlorinated dibenzo-p-dioxins;PCDDs	See Note 8	Dibenzo[b,e] [1,4]dioxin, chloro derivatives	8280	0.01
Polychlorinated dibenzofurans; PCDFs	See Note 9	Dibenzofuran, chloro derivatives	8280	0.01
Pentachlorobenzene	608-93-5	Benzene, pentachloro-	8270	10
Pentachloroethane	76-01-7	Ethane, pentachloro-	82608270	5 10
Pentachloronitrobenzene	82-68-8	Benzene, pentachloronitro-	8270	10
Pentachlorophenol	87-86-5	Phenol, pentachloro-	8041 8270	5 50
Phenacetin	62-44-2	Acetamide, N-(4-ethoxyphenyl)	8270	10
Phenanthrene	85-01-8	Phenanthrene	8100 8270	200 10
Phenol	108-95-2	Phenol	8041 8270	1 10
p-Phenylenediamine	106-50-3	1,4-Benzenediamine	8270	10

Common Name[2]	CAS RN[3]	Chemical abstracts service index name[4]	Suggested methods[5]	PQL (mg/L)[6]
Phorate	298-02-2	Phosphorodithioic acid,O,O-diethyl S-[(ethylthio)methyl] ester	8141 8270	2 10
2-Picoline	109-06-8	Pyridine, 2-methyl-	8260 8270	5 10
Pronamide	23950-58-5	Benzamide, 3,5-dichloro-N-(1,1-dimethyl-2-propynyl)-	8270	10
Propionitrile; Ethyl cyanide	107-12-0	Propanenitrile	8015 8260	60 5
Pyrene	129-00-0	Pyrene	8100 8270	200 10
Pyridine	110-86-1	Pyridine	8260 8270	5 10
Safrole	94-59-7	1,3-Benzodioxole, 5-(2-propenyl)-	8270	10
Selenium	(Total)	Selenium	6010 7010	750 20 20
Silver	(Total)	Silver	6010 7010	70 100
Silvex; 2,4,5-TP	93-72-1	Propanoic acid, 2-(2,4,5-Trichlorophenoxy)-	8151	2
Styrene	100-42-5	Benzene, ethenyl-	8021 8260	1 5
Sulfide	18496-25-8	Sulfide	9031	10,000
2,4,5-T; 2,4,5-Trichlorophenoxyacetic acid	93-76-5	Acetic acid, (2,4,5-trichlorophenoxy)-	8151	2
2,3,7,8-TCDD; 2,3,7,8-Tetrachlorodibenzo-p-dioxin	1746-01-6	Dibenzo[b,e] [1,4]dioxin, 2,3,7,8-tetrachloro-	8280 8290	0.005
1,2,4,5-Tetrachlorobenzene	95-94-3	Benzene, 1,2,4,5-tetrachloro	8270	10
1,1,1,2-Tetrachloroethane	630-20-6	Ethane, 1,1,1,2-tetrachloro-	8021 8260	5 5
1,1,2,2-Tetrachloroethane	79-34-5	Ethane, 1,1,2,2-tetrachloro-	8021 8260	0.5 5

Common Name[2]	CAS RN[3]	Chemical abstracts service index name[4]	Suggested methods[5]	PQL (mg/L)[6]
Tetrachloroethylene; Perchloroethylene; Tetrachloroethene	127-18-4	Ethene, tetrachloro-	8021 8260	0.5 5
2,3,4,6-Tetrachlorophenol	58-90-2	Phenol, 2,3,4,6-tetrachloro-	8270	10
Tetraethyl dithiopyrophosphate; Sulfotepp	3689-24-5	Thiodiphosphoric acid ($[(HO)_2P(S)]_2O$), tetraethyl ester	8270	10
Thallium	(Total)	Thallium	6010 7010 7000	400 1,000 10
Tin	(Total)	Tin	, 6010, 7000	8,000
Toluene	108-88-3	Benzene, methyl-	8021 8260	2 5
o-Toluidine	95-53-4	Benzenamine, 2-methyl-	8270	10
Toxaphene	8001-35-2	Toxaphene	8081	2
1,2,4-Trichlorobenzene	120-82-1	Benzene, 1,2,4-trichloro-	8270	10
1,1,1-Trichloroethane; Methylchloroform	71-55-6	Ethane, 1,1,1-trichloro-	8260	5
1,1,2-Trichloroethane	79-00-5	Ethane, 1,1,2-trichloro-	8021 8260	0.2 5
Trichloroethylene; Trichloroethene	79-01-6	Ethene, trichloro-	8021 8260	1 5
Trichlorofluoromethane	75-69-4	Methane, trichlorofluoro-	8021 8260	10 5
2,4,5-Trichloropehenol	95-95-4	Phenol, 2,4,5-trichloro	8270	10
2,4,6-Trichlorophenol	88-06-2	Phenol, 2,4,6-trichloro-	8041 8270	5 10
1,2,3-Trichloropropane	96-18-4	Propane, 1,2,3-trichloro-	8021 8260	10 5
O,O,O-Triethylphosphorothioate	126-68-1	Phosphorothioic acid, O,O,O-triethyl ester	8270	10
sym-Trinitrobenzene	99-35-4	Benzene, 1,3,5-trinitro-	8270	10

Common Name[2]	CAS RN[3]	Chemical abstracts service index name[4]	Suggested methods[5]	PQL (mg/L)[6]
Vanadium	(Total)	Vanadium	6010 7000 7010	80 2,000 40
Vinyl acetate	108-05-4	Acetic acid, ethenyl ester	8260	5
Vinyl chloride	75-01-4	Ethene, chloro-	8021 8260	2 10
Xylene (total)	1330-20-7	Benzene, dimethyl-	8021 8260	5 5
Zinc	(Total)	Zinc	6010, 7000 7010	20 50

Appendix 5 Endnotes

1. The regulatory requirements pertain only to the list of substances; the right hand columns (Methods and PQL) are given for informational purposes only. See also footnotes 5 & 6.
2. Common names are those widely used in government regulations, scientific publications, and commerce; synonyms exist for many chemicals.
3. Chemical Abstracts Service registry number. Where "Total" is entered, all species in the ground water that contain this element are included.
4. CAS index names are those used in the 9th Cumulative Index.
5. Suggested methods refer to analytical procedure numbers used in the EPA publication, SW-846, "Test Methods for Evaluating Solid Waste", Third Edition. Analytical details can be found in SW-846 and in documentation on file at the Agency that0 were promulgated methods through Update IV of SW-846 and, as of Update IV.
6. Practical Quantitation Limits (PQLs) are the lowest concentrations of analytes in ground waters that can be reliably determined within specified limits of precision and accuracy by the indicated methods under routine laboratory operating conditions. The PQLs listed are generally stated to one significant figure. **CAUTION**: The PQL values in many cases are based only on a general estimate for the method and not on a determination for individual compounds; PQLs are not a part of the regulation.
7. Polychlorinated biphenyls (CAS RN 1336-36-3); this category contains congener chemicals, including constituents of Aroclor-1016 (CAS RN 12674-11-2), Aroclor-1221 (CAS RN 11104-28-2), Aroclor-1232 (CAS RN 11141-16-5), Aroclor-1242 (CAS RN 53469-21-9), Aroclor-1248 (CAS RN 12672-29-6), Aroclor-1254 (CAS RN 11097-69-1), and Aroclor-1260 (CAS RN 11096-82-5). The PQL shown is an average value for PCB congeners.
8. This category contains congener chemicals, including tetrachlorodibenzo-p-dioxins (see also 2,3.7,8-TCDD), pentachlorodibenzo-p-dioxins and hexachlorodibenzo-p-dioxins. The PQL shown is an average value for PCDD congeners.
9. This category contains congener chemicals, including tetrachlordibenzofurans, petnachlorodibenzofurans, and hexachlorodibenzofurans. The PQL shown is an average value for PCDF congeners.